

Exhibit A

to

Complaint for Patent Infringement

The '888 Patent



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Roskowski

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(54) **BANDWIDTH SHAPING CLIENT TO CAPTURE, TRANSFORM, CACHE, AND UPLOAD IMAGES FROM A REMOTE POINT OF RECORDATION TO A NETWORK SERVICE**

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(51) **Int. Cl.**
H04N 7/18 (2006.01)

(52) **U.S. Cl.**
USPC **348/143; 348/152**

(58) **Field of Classification Search**

USPC 348/143, 152
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,970,183 B1 *	11/2005	Monroe	348/143
2004/0093409 A1 *	5/2004	Thompson et al.	709/224
2004/0181690 A1 *	9/2004	Rothermel et al.	713/201
2008/0259179 A1 *	10/2008	Senior et al.	348/222.1
2009/0219392 A1 *	9/2009	Roskowski	348/143
2010/0220202 A1 *	9/2010	Roskowski	348/211.3

* cited by examiner

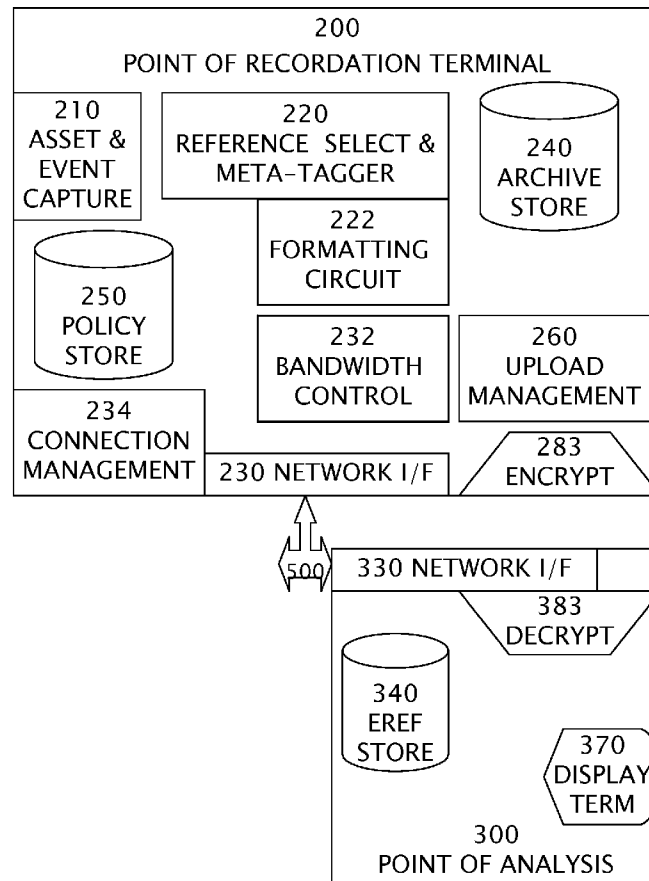
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(57) **ABSTRACT**

A video surveillance terminal avoids network congestion. The camera lowers exposure to unauthorized operation. Each apparatus discards unviewed higher resolution streams unless expressly desired by a host user. The client of the service determines an event of interest, selects an extent of data to represent the event, and derives a compact representation by video encoding and compression.

9 Claims, 8 Drawing Sheets



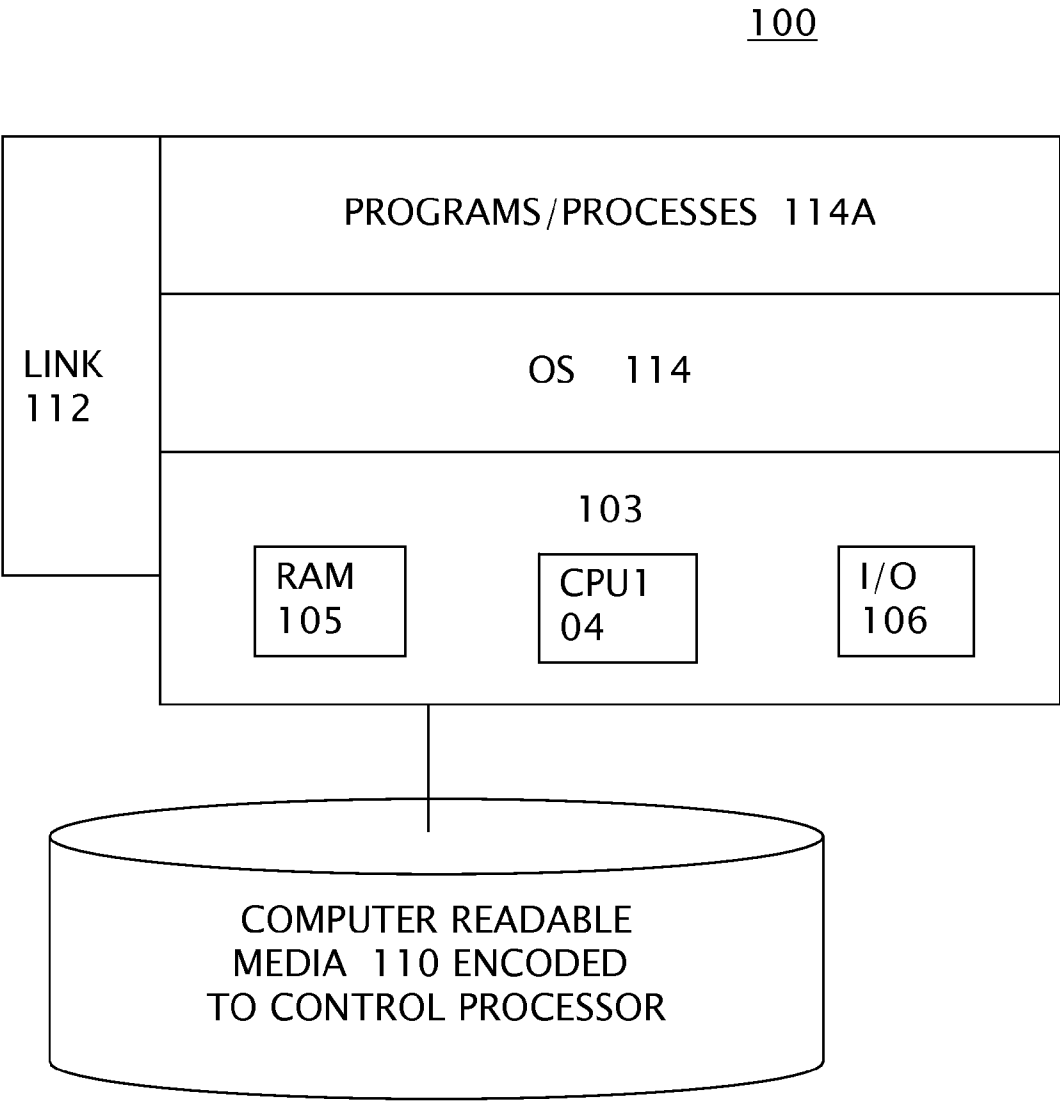


FIG. 1

U.S. Patent

Oct. 15, 2013

Sheet 2 of 8

US 8,558,888 B2

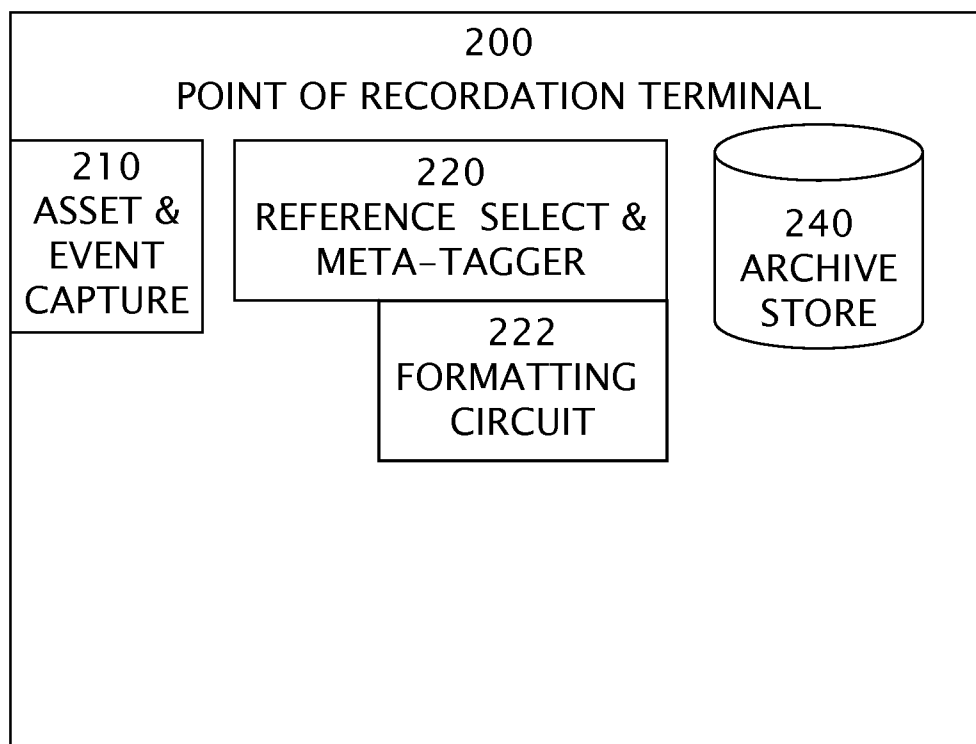


FIG. 2

U.S. Patent

Oct. 15, 2013

Sheet 3 of 8

US 8,558,888 B2

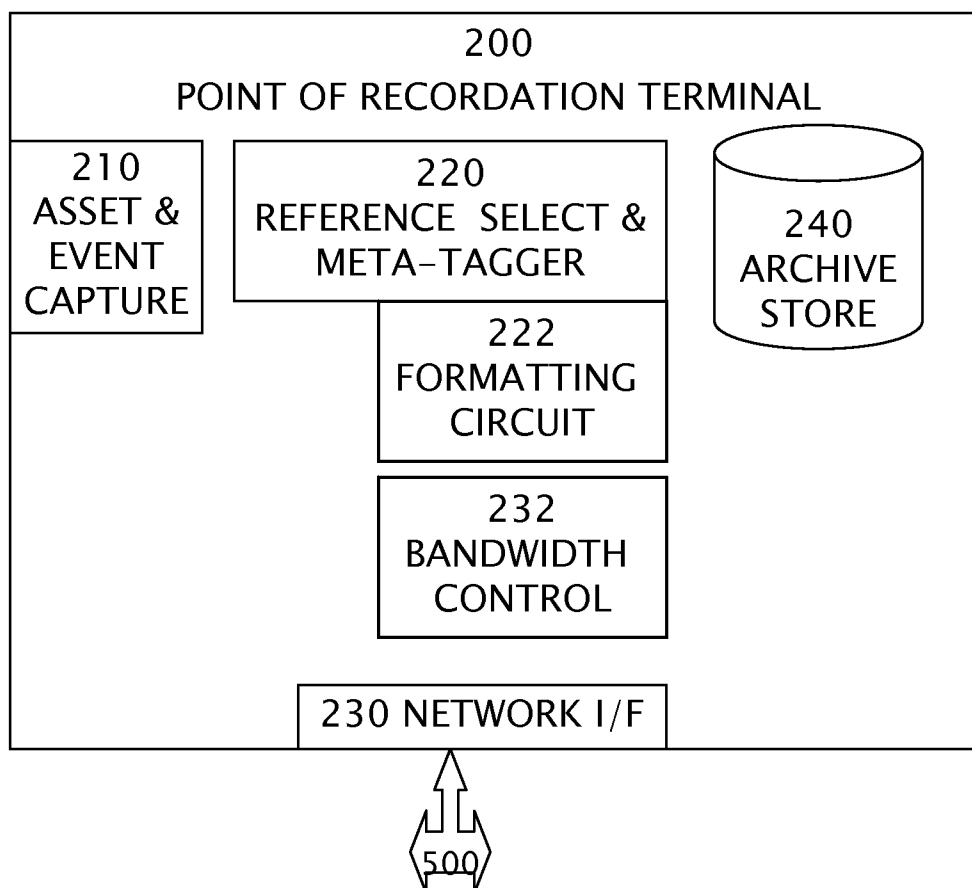


FIG. 3

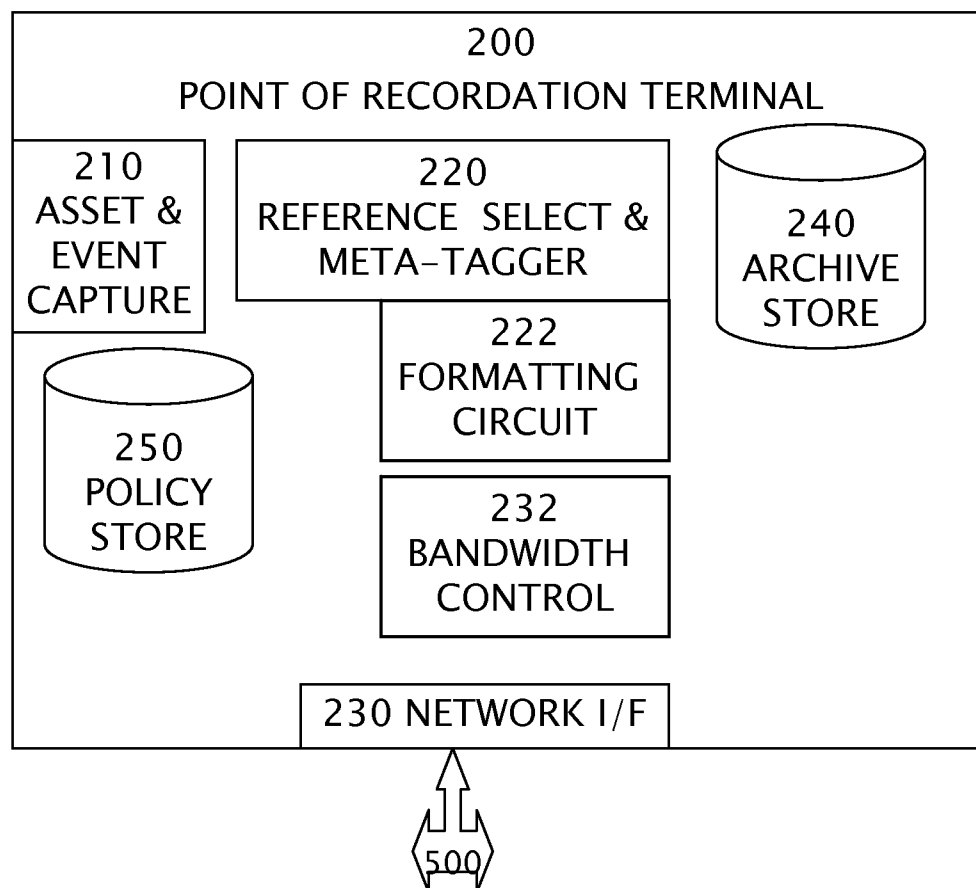


FIG. 4

U.S. Patent

Oct. 15, 2013

Sheet 5 of 8

US 8,558,888 B2

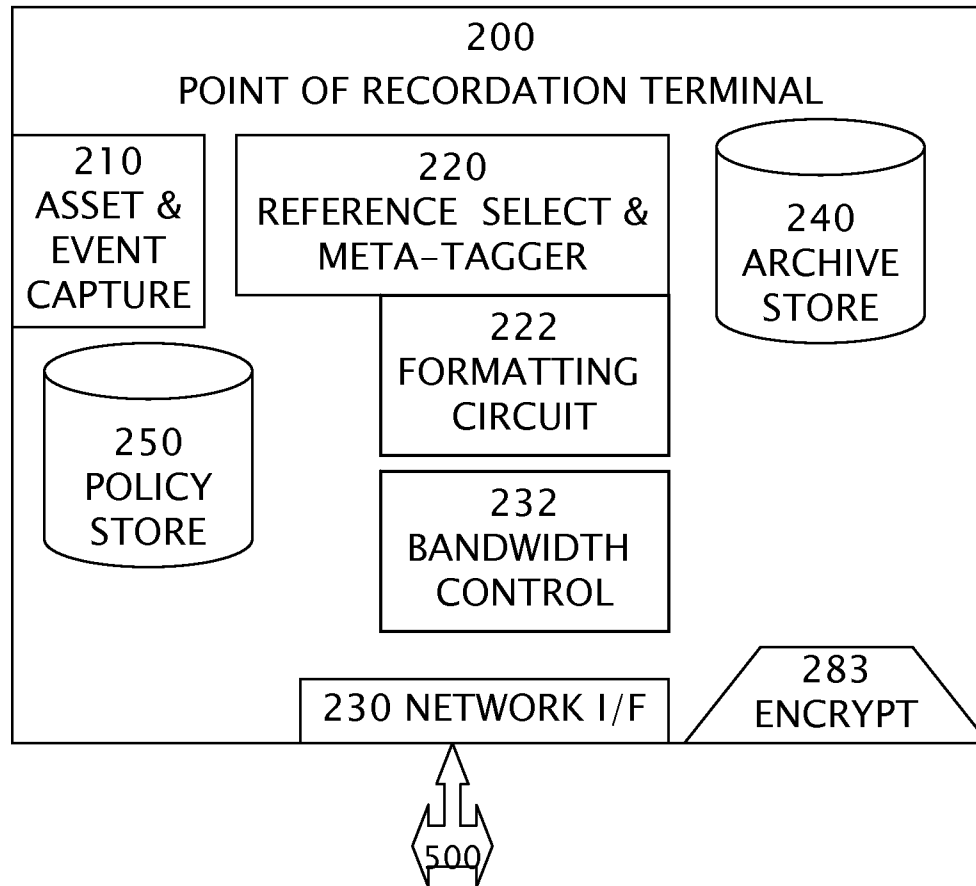


FIG. 5

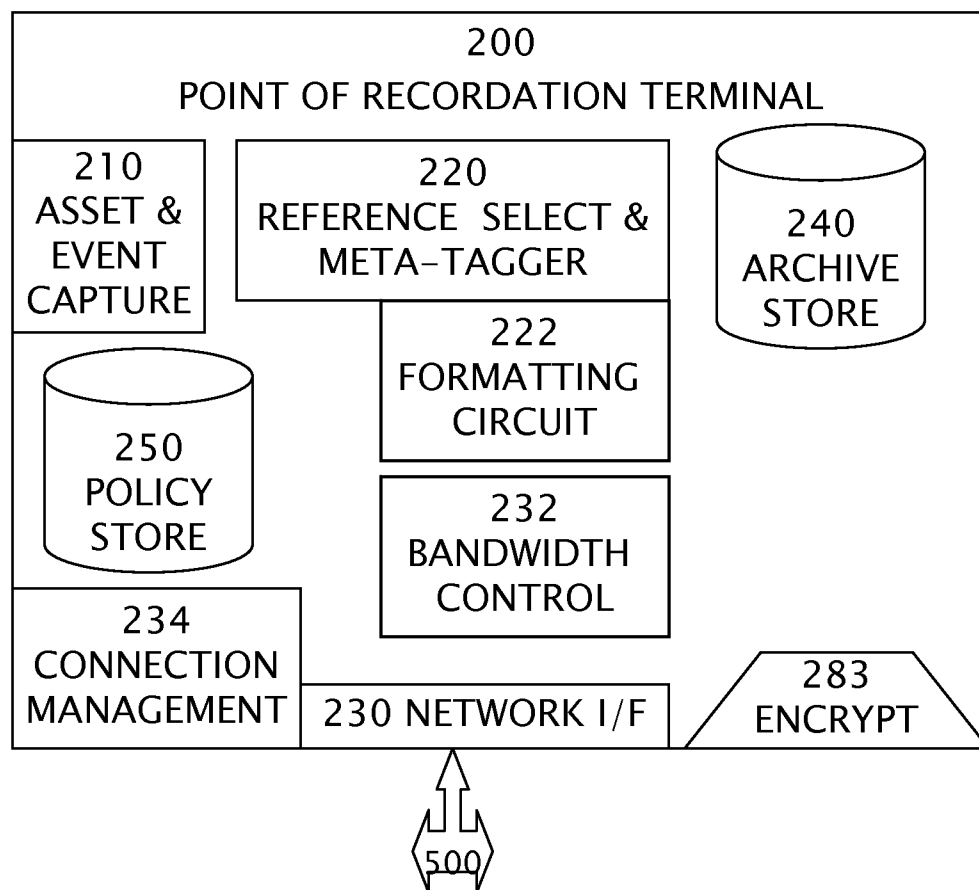


FIG. 6

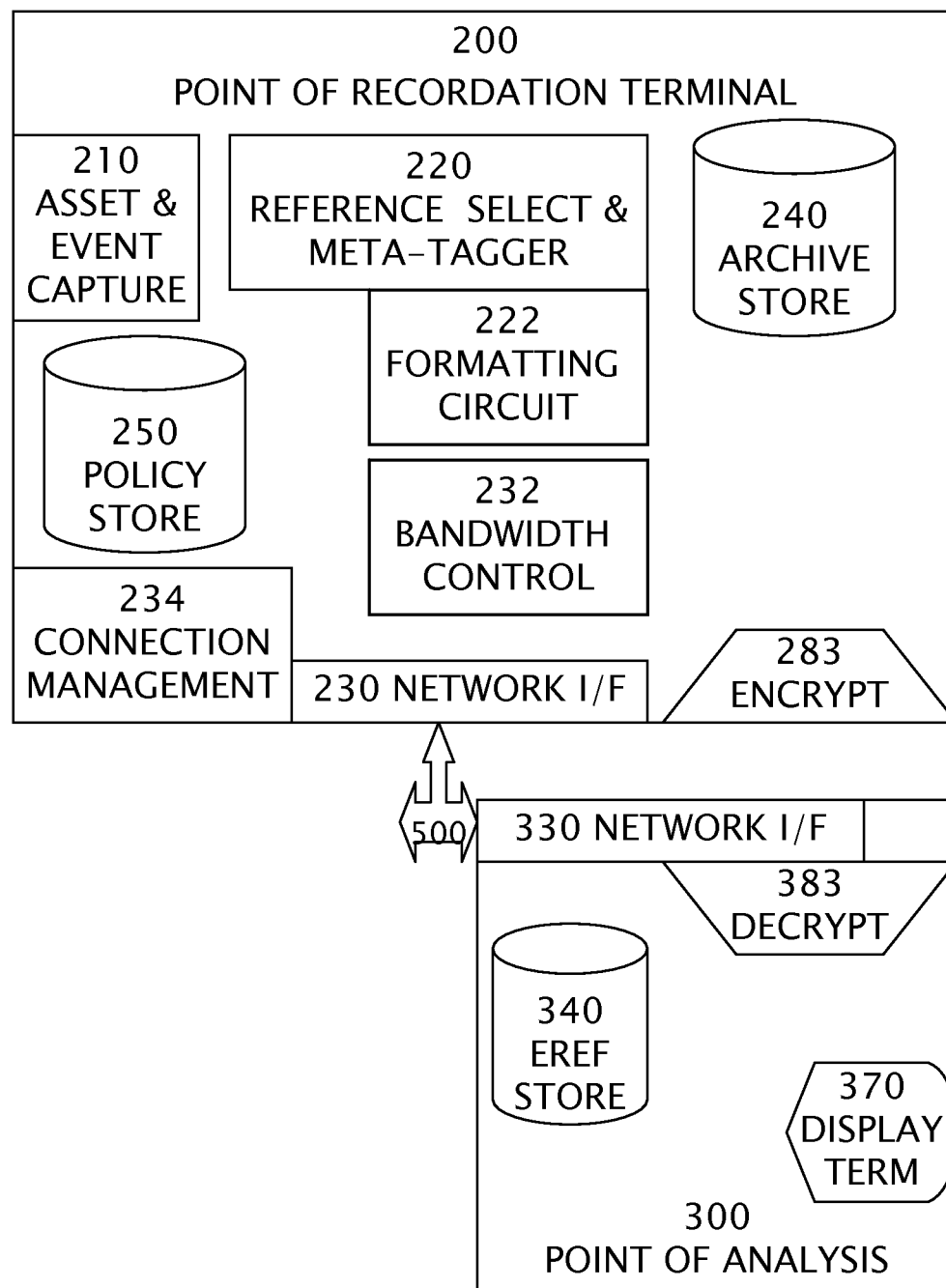


FIG. 7

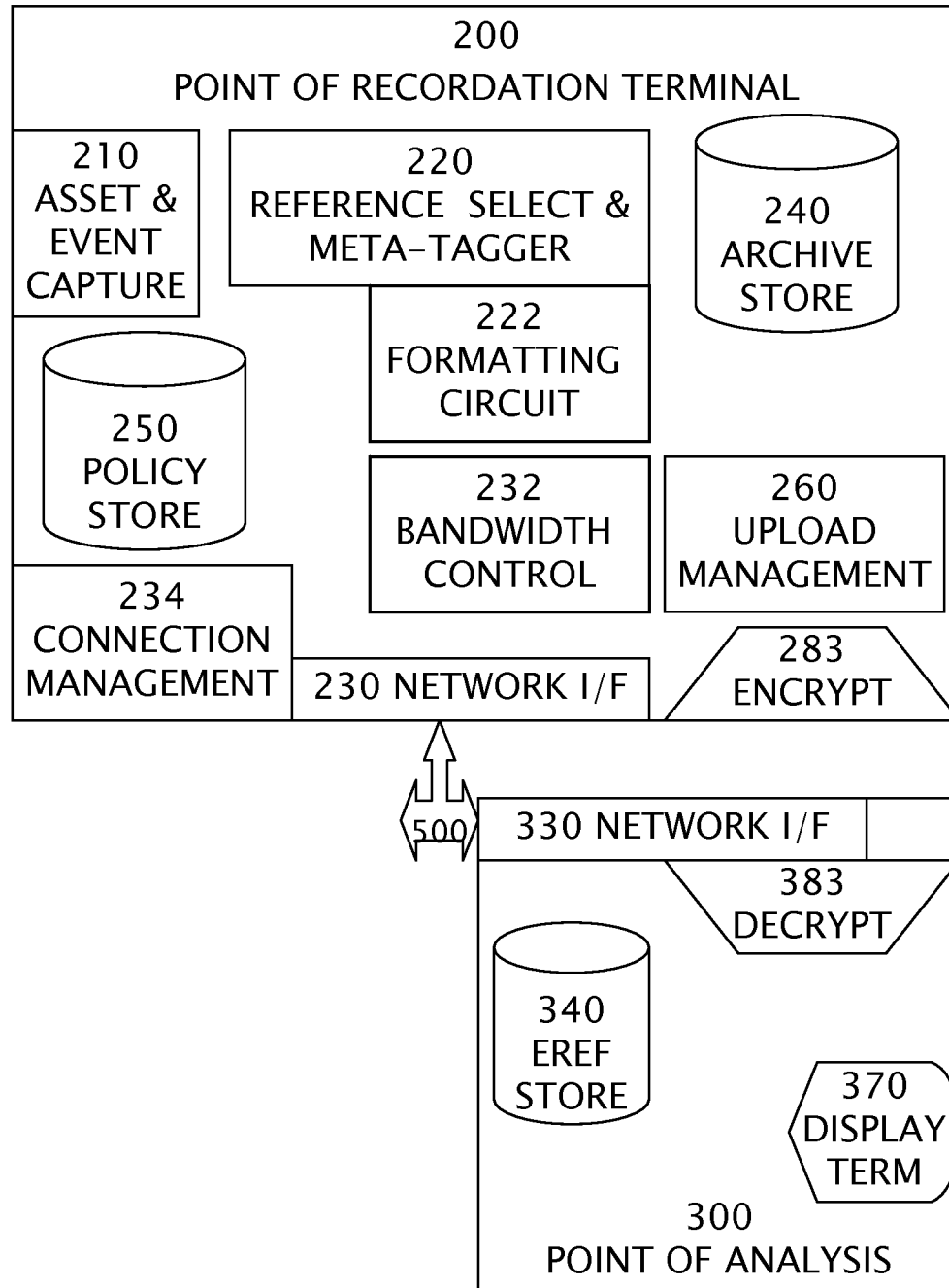


FIG. 8

US 8,558,888 B2

1

**BANDWIDTH SHAPING CLIENT TO
CAPTURE, TRANSFORM, CACHE, AND
UPLOAD IMAGES FROM A REMOTE POINT
OF RECORDATION TO A NETWORK
SERVICE**

BACKGROUND

Security cameras are increasingly important for both enterprises and consumers. All levels of government are promoting installation of cameras to address fears of crime. Liability insurers may raise rates on customers who cannot document that their premises are controlled. But the market is bifurcated into extremely costly high end integrated services and low cost do-it-yourself system design projects for hobbyists. By high complexity image sequences the present invention includes high resolution digital photographs, lower resolution moving images in the form of a series of video frames, meta-data about the time, place, and conditions of the image, and derived data from quantitative metrics of the images and compressed low resolution extracts from images.

Internet Protocol (IP) network digital cameras are known as an accepted solution for security and monitoring. Utilizing IP networks instead of dedicated video connections to a local server dramatically improves system flexibility and can reduce connectivity and management complexity.

Conventional IP network camera system design requires “logging in” to each camera. Typically, each camera implements a website for user access. After a user connects to a camera, he or she may then view data, configure the camera, control conventional camera pan, tilt, and zoom (PTZ) functions, or view a real time stream of image data. In common applications, people also want to record the video to allow an analysis of events either missed in real time or not observed with the necessary attention.

Conventional cameras can be configured to send an email including images when an event happens. Conventional cameras can be configured to broadcast or stream video. Conventional cameras can be configured to perform a file transfer protocol (FTP) transaction, in a non-limiting example, uploading at least one image. While this is closer to a desired end user functionality, conventional implementations require extensive network application and system engineering and only result in transfer of limited amounts of information. For example it is observed by the inventors that configuration of each network environment consists at least of opening ports, mapping addresses, managing a difficult maintenance and operations model to be assured that the system is working when needed, and addressing security concerns. For example, is the equipment on premises vulnerable to theft or damage, can end users properly configure the network and the specific camera device, what steps are needed to easily record and analyze the video.

To allow live access to cameras, a user should be able to configure firewalls if external access is to be allowed and to configure an IP address resolution service such as a dynamic DNS application. Because the solution depends on an occasional user to define and configure each security installation, deployed solutions have been known to exhibit very poor security such as unintended publicly viewable webcams.

It is known that configuring for recording video is even more complex than simply viewing it. The typical solution requires selecting and installing an additional system into the user's local network to record the video, configuring the cameras to transmit incoming data in a manner compatible with the recording system, and assuring all network configurations are correct to allow reliable communication between

2

cameras and recording systems. This introduces additional hardware to be configured and maintained. It creates an additional exposure for assets to be stolen or damaged. Prior to beginning the installation, users must determine how large and complex a system they will ultimately require or some procurement will turn out to be inadequate and soon obsolete.

To utilize outbound FTP functionality, the user of conventional systems must configure a server to accept the FTP transactions and configure the camera to upload the data appropriately. Further, since the FTP transaction is typically not in real time, the size is limited by the amount of memory available for storage on the device. Alternately an email solution can be considered. Unfortunately, e-mail cannot typically provide true video recording. Limitations of email servers and email accounts constrain the email alert model to only a few images. Further, since email does not enable realtime streaming of data to the email server, the total size of the stored video is limited to the storage on the device.

Conventional video security systems do not enable proactive monitoring of their status. End users occasionally discover when an event occurs in their premises, that their system was not functioning correctly and that they do not have the desired critical information despite having made investments into both cameras and recording systems. Since video monitoring systems are typically not core to the business of most enterprises, but supportive, the resources allocated to maintain the system are frequently inadequate, insufficient, or lack the proper expertise to maintain the system effectively. This results in many video systems being effectively turned off after a period of time as the cost and complexity of maintaining the system overwhelms the day to day benefits. Only the largest governmental or private enterprises have continuous human monitoring of all cameras.

The challenge of maintaining operational systems has been addressed in other domains effectively by adopting a “service model” where minimal equipment is onsite and a centralized service provides functionality to a large pool of users. Video monitoring has historically been unable to use this model effectively due to the high bandwidth required to effectively record usable quality video. While this bandwidth can be addressed in local area networks, a service model with centralized recording requires video to be sent over a wide area network such as the Internet, and such connection may be costly and typically limited. For example many business have traditionally had “T1” connectivity, which is bidirectional at about 1 megabit per second. A single camera with high quality video in traditional implementations uses 2-3 megabits of bandwidth, making a conventional service based model impractical.

The benefits of a service based model would be significant. One key benefit is the ability to use shared resources across a larger number of customers. This amortizes the cost of equipment, monitoring and maintenance, allowing very high levels of service at manageable costs. In the area of equipment and management, it is known a single logical storage volume, potentially made up of a very large number of physical volumes, can be shared amongst a large number of users if there are sufficient safeguards for privacy. Using a single large logical storage volume allows for significant individual variance in usage patterns to be efficiently addressed. A single large logical storage volume also allows additional reliability and maintenance investments to be amortized over the entire user set, significantly increasing reliability and reducing costs.

Similarly it is known that a set of processing elements can be efficiently shared amongst a plurality of sporadic processing demands. The virtual machine model is one well known

US 8,558,888 B2

3

implementation that allows processing to be allocated and de-allocated to processing resources on demand. Several other processing models are known ways of distributing computational demands over a large number of processing elements. The models include pipelining, where a single processing element performs a small part of the overall function for multiple processing demands, and threading, where a single process is divided into multiple logical subprocesses.

These processing and storage models have been optimized in a computational architecture commonly called "cloud computing". In cloud computing a very large number of machines and a very large amount of logical storage is made available in an on-demand basis to a large body of customers. Customers can increase and decrease the amount of computational resources allocated to them on a demand basis. Each computation resource is some version of a virtual machine, which can then be further partitioned into individual user computation needs as outlined above. Cloud computing also provides cloud storage, where a very large amount of storage is made available on a demand basis, allowing customers to allocate and de-allocate storage as needed. One example of cloud computing is Amazon's Elastic Computing Cloud (EC2). One example of cloud storage is Amazon's Simple Storage Service (S3).

The following processes are known in the art as methods for motion detection: processing a constant sequence of images (video), establishing a reference image of the scene with only background items, detecting when pixels are changed sufficiently in subsequent images to indicate areas in motion, counting the number of pixels in motion to determine if enough have changed to indicate an event of interest, and updating the background image for areas that have changed minimally. Significant improvements are known on this basic algorithm including object detection and object recognition. Thus it can be appreciated that what is needed is an apparatus which makes deployment, maintenance, and operation of IP network cameras much less complex. What is needed is equipment that is extremely easy to set up and maintain by using a cloud computing infrastructure and strategy.

SUMMARY OF THE INVENTION

A novel implementation of a security camera, is a Point of Recordation Terminal (PORT) apparatus disclosed as follows. In use, a plurality of point of recordation terminals (PORTs) are distributed among small and medium sized enterprises for installation in their respective private networks. Each PORT captures and analyzes images to determine if there is an event of interest. Events of interest are compressed, formatted and stored to construct an asset. A reference to each asset is transmitted in near real-time comprising a compressed single frame, time, date, meta-data associated with the assets not transmitted and identity of the terminal. The reference provides sufficient information to uniquely access the associated asset on the specific PORT. The PORT provides a mechanism for a Point of Analysis (POA) apparatus to access the associated asset at a later time if desired.

The method for defining an event of interest results in identification of a sequence of images which span the event of interest. In an embodiment the sequence of images is compressed with a video compressor circuit to create the video asset. In an embodiment, some images can be stored in anticipation of the beginning of an event of interest, keeping a constant record of the last several images. This sequence of images is provided to the compression circuit before the images associated with the event of interest, providing a short

4

"preroll" of video of the images leading up to the event of interest. In an embodiment, the sequence of images provided to the compressor circuit can be continued after the end of the event of interest to provide a "postroll" of video of images after the event of interest.

The PORT comprises a bandwidth controller circuit which regulates the archiving, purging and transmission of assets and references under direction of a plurality of policies. Policies are selected based on a plurality of conditions including PORT application, date and time, configured bandwidth utilization, PORT status, and network connectivity status. A mechanism is provided to allow the POA to change policies and policy selection criteria. The PORT contains unique identification information to allow it to be securely and unquestionably associated with certain resources on the POA. The PORT also comprises a means for encrypting and signing assets and references independent of data transport allowing a POA to securely maintain the uploaded content and to validate with a high degree of confidence the providence of the assets transmitted from the PORT.

The PORT comprises means for automatically determining its network environment and contacting the POA with minimal or no user configuration. The PORT utilizes only data connection initiated by the PORT to a known location for the POA to function in any local network without user configuration of the PORT or the local network environment. One means is a processor controlled by software to perform network exploration and self-configuration as disclosed below.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a processor adapted to perform as a circuit according to the present invention.

FIG. 2-8 are block diagrams of a point of recordation terminal embodiments.

DETAILED DESCRIPTION OF EMBODIMENTS

The embodiments discussed herein are illustrative of one example of the present invention. As these embodiments of the present invention are described with reference to illustrations, various modifications or adaptations of the methods and/or specific structures described may become apparent to those skilled in the art. All such modifications, adaptations, or variations that rely upon the teachings of the present invention, and through which these teachings have advanced the art, are considered to be within the scope of the present invention. Hence, these descriptions and drawings should not be considered in a limiting sense, as it is understood that the present invention is in no way limited to only the embodiments illustrated.

In embodiments of the invention there are circuits for encrypting video frames at the point of recordation terminal (PORT) apparatus. In an embodiment references, assets, or both are encrypted before storage. In an embodiment references, assets, or both are encrypted before transmission through a public network.

FIG. 1 shows a block diagram of a typical computing apparatus 100 where the preferred embodiment of this invention can be practiced. The computer apparatus 100 includes a computer platform having a hardware unit 103, that implements the methods disclosed below. The hardware unit 103 typically includes one or more central processing units (CPUs) 104, a memory 105 that may include a random access memory (RAM), and an input/output (I/O) interface 106. Various peripheral components such as a camera may be connected to the computer platform 102. Typically provided

US 8,558,888 B2

5

peripheral components include a data storage device (e.g. flash, or disk) **110** where the policies and images used by the preferred embodiment is stored. A link **112** provides access to the global Internet. An operating system (OS) **114** coordinates the operation of the various components of the computer system **100**, and is also responsible for managing various objects and files, and for recording certain information regarding same. Lying above the OS **114** is a software layer **114A**. The user layer **114A** runs above the operating system and enables the execution of programs using the methods known to the art and is where most processing as described typically occurs.

An example of a suitable CPU is a Xeon™ processor (trademark of the Intel Corporation); examples of an operating systems is Wind River RTOS. Those skilled in the art will realize that one could substitute other examples of computing systems, processors, operating systems and tools for those mentioned above. As such, the teachings of this invention are not to be construed to be limited in any way to the specific architecture and components depicted in FIG. 1.

Referring further to the drawings, FIG. 2 is a block diagram of a point of recordation terminal apparatus. A point of recordation terminal apparatus **200** comprises an asset & event capture circuit **210** comprising a high resolution digital camera, a video encoding & compression circuit, and an image encoding & compression circuit; the asset & event capture circuit coupled to a reference selection & meta-tagger circuit **220** and the reference selection and meta-tagger circuit couples to a formatting circuit **222** and further coupled to an asset and reference archive store **240**. When it has been determined that the asset capture circuit has detected an event of interest, an asset is initiated and processed as directed by the appropriate policy, normally storing into an archive. As the asset is being generated, a reference is composed by selecting a representative frame of the video to scale and compress, recording the beginning of the event of interest, and accumulating relevant metadata about the generated assets. A processor controlled by computer-readable instructions to perform steps of the present invention is one means for circuits disclosed in this disclosure. In an embodiment, a video encoding and compression circuit is a h.264 encoding circuit. In an embodiment an image encoding and compression circuit is a JPEG encoding circuit.

Referring to FIG. 3, at least one point of recordation terminal **200** is coupled to a network **501** through its network interface **230**. In an embodiment, the network is a private network. In an embodiment, the network is a wireless cellular network. In an embodiment of the present invention, an apparatus comprises a point of recordation terminal **200** comprising a network interface **230**, the network interface coupled to a network **500**.

Referring to FIG. 4 The present invention is distinguished by executing policies stored in policy store **250** in a bandwidth controller circuit **232** to support and mutually benefit the methods of operating a wireless cellular network. Combined with identity information for the specific PORT, as directed by policy, the reference is transmitted through the network interface **230**. Policies also control what is determined to be an event and control the formatting circuit and control the bandwidth assigned.

Referring to FIG. 5, in an embodiment of the invention, references and assets are encrypted. In an embodiment assets and references are encrypted using a key in encryptor circuit **283** before transmission through the network interface **230**. In an embodiment, assets and references are encrypted within the point of recordation terminal **200** prior to archive store. By using encryption circuits, a public network **500** can be used to

6

lower the cost of providing these services. By using strong encryption keys with the assets and references, the resulting artifacts can be safely stored in environments with potential security flaws such as cloud services.

The encryption attached to the assets and reference clearly distinguishes the present invention from conventional systems which use transport level security. Once files have completed transport in a conventional system they can be read by anyone representing a continuing loss of privacy for as long as they are stored. In contrast the encrypted assets and references are stored in encrypted format and may never be decrypted at all before expiration. Because encryption securely associates the asset with the device and time of creation, there is provenance for the assets and references. In an embodiment, each unit has a unique private key of a key pair. It is known that a digital signature can establish the source of an image is a specific camera. This can be distinguished from conventional transport level security which does not provide provenance back to the specific PORT and time of the event of interest, and creates a security vulnerability as assets are processed and typically stored in a decrypted format.

Referring to FIG. 6, a method of operating the present invention during outage comprises the steps of the connection manager **234** determining from signals of the network interface that the network is congested or defective, selecting a policy defined for handling assets and references, the policy to control:

- storing references from the reference selection & meta-tagger circuit **220** into the archive store **240**,
- storing assets into the archive store **240** if there is available capacity,
- discarding stale assets in the archive store and storing new assets into the archive store,
- discarding new assets if it determines that there is no capacity,
- discarding new references if it determines that there is no capacity, and
- testing for restoration of network connectivity and improved bandwidth.

Referring to FIG. 6, the present invention comprises a method for operating an embodiment for recovery after network outage or congestion. In an embodiment, references are stored in the archive store **240** during network outage or congestion as controlled by the bandwidth controller **232**. In a non-limiting example, network congestion or outage could cause low or no bandwidth while the PORT **200** is itself operating and detecting events. When the method determines that the outage is ended or that bandwidth constraints have loosened, a new policy is selected, which directs that references which have been queued in archive **240** be transmitted immediately with no bandwidth restrictions.

Referring to FIG. 7, in normal, unattended operation the operation of a specific PORT apparatus **200** is as follows: as an assets and event capture circuit processes a plurality of images frames and determines if an event of interest is in progress, a policy based bandwidth controller circuit **232** selects the normal policy which directs it to store assets in the archive store **240** and transmit references immediately over the network interface **230** to connected network **500** to the designated POA.

Referring to FIG. 8, while processing, the upload manager **260** monitors the status of other elements, in an embodiment including archive store **240** to determine if it is nearing capacity and network interface **230** to determine if it is functioning correctly, and selects alternate processing policies for process assets according to the determined state. Alternate policies for

US 8,558,888 B2

7

archive store nearing capacity include deleting old assets, deleting selected old assets types (video, high resolution snapshots), and not storing new assets. Alternate policies for network connectivity are outlined earlier.

If connectivity between a point of recordation terminal and the network is lost or degraded, but the PORT is otherwise functional, it selects a different policy to guide storage and of assets and references.

In an alternative operating mode, the bandwidth controller is configured with a policy so that the PORT transmits assets and references as they occur. By storing a copy of the transmitted data while the transmission is occurring, the PORT can provide recovery of data in the event a transmission is determined to be unsuccessful while the transmission is occurring. When the transmission failure is detected, the remaining portions of the assets and references are generated as normal but not transmitted. When network connectivity is restored, recovery can be accomplished as above.

In an embodiment, a POA **300** may request a live feed from a specified PORT **200**. A live feed is differentiated from the asset and reference model in that no event of interest is necessarily involved. Instead the PORT artificially forces an event of interest to be created independent of the content of the images. The artificial event of interest has a reference image, typically determined by taking the first image in the sequence. Similarly, the other aspects of the event of interest are created independent of the data. If an event of interest does occur during the sequence of images created by the live stream, it is handled as described in multiple events of interest below. The PORT apparatus responds to the request for live streaming by selecting an appropriate policy, which typically directs the bandwidth controller to allow unlimited transfer of live asset information to the network interface **230**, passing the processed video information (encoded, formatted, and encrypted) directly to the network interface as it is generated, and indicating to the reference generation circuit that an artificial event is in progress.

In an embodiment a PORT includes a connection management circuit **234** for interacting with the POA outside of the upload of assets and references. The connection manager establishes an outbound connection to the POA to allow the PORT to function without requiring any inbound connections. Amongst other things, the connection manager is used to download and modify policies for the bandwidth controller. The connection manager also allows the POA to request the immediate upload of a specific stored asset. The PORT responds to this request by immediately transmitting the requested asset under a specific policy, typically no bandwidth constraints.

It is understood that a network may be a private network, a local area network, a public network, or a combination of the above such as the internet. Further, the network may be a wireless local network, a wireless cellular network, or a wired network. The invention is specifically distinguished in its ability to function with relatively low bandwidth and unreliable connections, as typically required for wide area networks, either wired or not. Each point of recordation terminal **200** is also coupled to the network by a network interface **230**. It is further understood that a network in the present patent application is defined to include proxies, pass-throughs, and other elements which do not change interface modality.

A point of recordation terminal further comprises an asset & event capture circuit **210**, a reference selection and meta-

8

tagger circuit, the network interface **230** coupled to the reference selection & meta tagger circuit and coupled to the archive store.

A PORT further comprises a connection management circuit **234** coupled to the network interface **230**. The connection management circuit establishes a connection to allow configuration and management of the PORT. Because the connection management circuit and the transmission circuit disclosed below both utilize a connection initiated from the PORT to the POA, they are compatible with typical network configurations such as NATs (network address translators, which fake a public IP address for a local network device with a private IP address) and Firewalls (which typically restrict almost all inbound traffic but little if any outbound transactions). In an embodiment, the connection is an HTTP request initiated by the PORT which is periodically timed out and re-initiated. If the POA has a configuration directive for the specific PORT in question, it responds to the HTTP request with the contents of the directive. Subsequent requests from the PORT provide the status and results of the configuration directive. Upon reception of the configuration directive, the PORT executes the command and re-initiates the connection. In an embodiment, the PORT executes directives with an extend duration by creating a separate process or thread to process the command, while re-establishing and maintaining the connection to the POA, and including in the connection the status of the commands currently executing. In an embodiment, when a directive finishes, the HTTP connection is immediately terminated and re-established with the final status of the directive, providing immediate feedback of directive completion.

An embodiment of the invention is a method comprising the processes of: determining if motion has occurred, defined as an event of interest, defining a small single image to represent the event of interest in a time correlated manner, locally imaging data at all times at all cameras, determining if locally analyzed images are not needed, not recording or transmitting except for minimal statistics information.

An embodiment of the invention is a process for recognizing an event of interest and storing an asset and at least one reference to associate as exemplary of the event. The process comprises known methods for motion detection, known methods for object detection, and known methods for object recognition and the following steps: triggering on matching an event of interest pattern within a certain sequence of images, selecting an exemplary image from the sequence, scaling the exemplary image, compressing the exemplary image, recording the start and end times of the event of interest, and additional metadata sufficient to efficiently process and uniquely address the associated asset on the PORT. In an embodiment, an exemplary image is selected from the sequence of images in motion as the image with the largest pixel difference from a reference image in the sequence. In an embodiment of the method, the method further comprises operating on the event of interest to generate a high resolution image asset. In an embodiment of the method, the method further comprises operating on the event of interest to create a very compact image representative. By operating on the event of interest is included the non-limiting examples of no scaling and compression, scaling and compressing in a highly lossy manner, and JPEG encoding. In an embodiment, the method further comprises the step of recording additional metadata derived from the event of interest, by computing the amount of motion detected on each frame and an indication of the current logical mode of the motion detection circuit, including preroll, motion, and postroll. In an embodiment the method further comprises creating reference information for

US 8,558,888 B2

9

an asset to facilitate the processing or retrieval of assets, in an embodiment the asset size in bytes.

It can be appreciated that the operation on an event of interest described is in anticipation of the POA providing primarily a direct user interface to allow humans to rapidly select events of interest for further analysis. In anticipated implementations of a PORT alternative reference and asset information will be captured to allow efficient computation processing of references to determine if an event of interest requires further analysis, and subsequent processing of the associated assets. Specifically, is known that object recognition algorithms can identify the type of object (such as car, person, face) being imaged and its location. Further it is known additional artifacts can be produced from such object recognition processing, such as the specific features and their spatial relationship. In support of a POA doing object processing, a reference would contain limited categorization information and the reference would contain the detailed object features. Thus the PORT architecture of references and assets should not be constrained to the specific type of references and assets disclosed.

In an embodiment of the invention, the PORT further comprises an asset upload manager circuit. The upload manager circuit functions under a selected policy to send assets to the POA without request from the POA. In anticipation of the POA needing a significant percentage of the assets, and in acknowledgement that a PORT must have limited archive capacity, the upload manager attempts to send assets proactively to the bandwidth controller 232 for transmission. The bandwidth controller selects a policy appropriate for the background upload of assets (typically a significantly limited bandwidth allocation) and sends the assets at or below the defined rate. The upload manager also tracks the status of reference and assets in the archive, and under policy control can immediately delete references and assets once they have been transmitted, delete them when the archives near capacity, or not delete selected or all assets. In practice, the events of interest occur infrequently and have limited duration, the background transmission of assets can be accomplished in a small fraction of the bandwidth required for transmitting the data in real-time. The upload manager policy can be selected based on conditions including the current status of the archive store, and the time of day and day of the week. Policies for the upload manager include sending all assets in order of storage, sending assets in reverse order of storage, and sending selected types of assets first, followed by different type of assets. In an embodiment, an upload manager circuit comprises a processor coupled to a policy store, the policy store comprising computer readable media encoded with instructions to adapt the processor to perform the above disclosed steps and processes. The policy store is further coupled to the connection manager whereby the contents of the policy store can be initially configured and updated.

The present invention comprises a computer implemented method for archive transmittal containing the steps of storing assets locally to the PORT, tracing assets through a common ID in reference data to allow an arbitrary delay between capture and upload of the asset, limited only by the storage available in the PORT. As the bandwidth controller determines that bandwidth is underutilized, assets are transmitted using the established reference information to allow a POA to associate the assets uploaded in the this background manner with the originating reference data. A policy guides but does not dictate the operation of the bandwidth controller. In an embodiment, a policy assigns bandwidth by time of day and day of week. In an embodiment, the policy assigns bandwidth during network failures by defining the amount of time to wait

10

in response to a network failure before attempting transmission of a stored asset. In an embodiment, the bandwidth controller may autonomously adapt the policy to use more bandwidth if the asset store is becoming full.

In an embodiment of an apparatus for documenting at least one occurrence of an event of interest the apparatus comprises a digital camera coupled to a network interface, the camera, and the network interface coupled to the following:

a means for determining when an event of interest occurs, in an embodiment a circuit comprising a processor controlled by software to execute the following computer-implemented steps: motion threshold, and

a means for selecting an extent of data associated with the event of interest to accurately represent the event, in an embodiment a circuit comprising a processor controlled by software to execute the following computer-implemented steps: marking motion activity plus a preroll and postroll, motion object tracking with analysis artifacts;

a means for efficiently recording the selected extent of data in an embodiment a circuit comprising a processor controlled by software to execute at least one of the following computer-implemented steps: to h264 encode, to JPEG encode;

a means for storing the recorded events in an embodiment a circuit comprising a processor controlled by software to execute the following computer-implemented steps: to write to flash memory, to write to SD-card, SDXC-card, SDHC-card or equivalent non-volatile memory card, to write to disk; and

a means for deriving more compact representations of the event which can assist in determining if the event is of further interest, in an embodiment a circuit comprising a processor controlled by software to execute the following computer-implemented steps: to generate highly compressed images, timestamps, motion metadata, and descriptive information for each asset.

In an embodiment, a means for determining when an event of interest occurs in an embodiment a circuit comprises a processor controlled by software to execute the following computer-implemented steps: to determine if multiple events of interest occur in close proximity, to cause a single extent of data to be recorded indicative of multiple event representations, each of which provide indication of where in the extent the event occurred. In an embodiment, if during an event of interest or during the postroll period after an event of interest, a new event of interest is determined to occur, a new set of reference data and image asset data is generated, and the sequence of images captured is continued to included the subsequent event of interest. The reference data and assets have an offset associated with them to indicate at which number in the sequence of images represented by the compressed video they occur.

In an embodiment, a means for storing recorded events and a means for deriving compact representations comprises a circuit comprising a processor controlled by software to execute the following computer-implemented steps: to encrypt data for later decryption

In an embodiment a means for storing the recorded events comprises in an embodiment a circuit comprising a processor controlled by software to execute the following computer-implemented steps: to store them locally on the device and to transmit according to a policy implemented in a bandwidth controller circuit.

In an embodiment an apparatus for transmitting compact representations of an event of interest over an unreliable network comprises,

US 8,558,888 B2

11

a means for connection comprising at least one of a private network, an IP network, a cellular network, or an IP network over cellular network;

the means for connection coupled to a first network interface circuit and to a second network interface circuit, the first network interface circuit coupled to a means for transmission of compact representations,

wherein the means for transmission of compact representations comprises in an embodiment a circuit comprising a processor controlled by software to execute the following computer-implemented steps: to determine if the representation cannot be immediately transmitted, to store the representations locally and to retry transmission at a later time; and a means for reception coupled to the second network interface,

A PORT comprises a transmission circuit which transmits data to a POA. In an embodiment, the PORT transmission circuit is a processor adapted by a software implementation of the HTTP protocol, which initiates a separate transaction for uploading each set of references and assets associated with a event of interest. In an embodiment for streaming, the PORT transmission circuit is adapted to perform the method of the HTTP chunked data transmission model which incrementally transfers large media assets as they are generated. In an embodiment, the PORT transmission circuit maintains a record of data transmitted but not acknowledged by the protocol, and in the event the HTTP transaction fails to complete correctly, the information can be stored in the local archive for later recovery.

In an embodiment, a PORT further comprises a formatting circuit which processes the compressed video to a format that allows streaming without reformatting as well as storage (RTP based protocols allow streaming, MPEG 4 allow storage but not both). In an embodiment the video is formatted in the flash FLV format for H.264 video. In an embodiment, a formatting circuit of the PORT couples to the archive store and to a bandwidth controller and to a policy store to interpret a standard H.264 bit stream or reference format and convert the data stream directly into the FLV format while adding minimal (less than a frame) of latency.

In an embodiment, a PORT further comprises a video encoder circuit which runs constantly, to generate a valid H.264 video stream. In an embodiment, a PORT further comprises a formatting circuit coupled to a video encoder circuit to detect reference or key frames (I Frames in H.264 nomenclature) and always starts video sequences at I Frame boundaries. In an embodiment, a PORT further comprises a transmission circuit which stores a sequence of compressed video frames starting with an I Frame as a preroll buffer, enabling preroll buffering in the compressed space, significantly reducing the storage required for preroll.

In an embodiment a point of recordation terminal comprises a circuit comprising a processor controlled by software to execute at least one of the following computer-implemented steps:

- to change configuration of other circuits in the terminal,
- to transmit immediately when directed by means for analysis,
- to store events if immediate transmission fails, and
- to specify all data should be recorded and transmitted immediately for a limited period.

In an embodiment the invention comprises a method for operating an apparatus to reliably represent high complexity continuous data over a low bandwidth and unreliable connection, the apparatus comprising:

- a point of recordation terminal (PORT) coupled to a connection,

12

the connection comprising at least one of an IP network, a cellular network, and an IP over cellular network, the method comprises capturing, and transmitting an event of interest,

wherein capturing an event of interest comprises the following processes:

- determining when an event of interest occurs,
- selecting an extent of data associated with the event of interest,
- efficiently recording the selected extent of data,
- deriving a compact representation of the event of interest, and
- storing the recorded events;

wherein transmitting an event of interest comprises the following processes:

- transmitting immediately when directed and storing if immediate transmission fails,
- opening an client session to a server at a designated address
- transmitting data over the session,
- maintaining a record of data transmitted but not acknowledged,
- recording the record of data in the event the transmission session fails
- storing recorded events locally and transmitting when an acceptable amount of bandwidth becomes available, and
- responding to subsequent request to immediately transmit a stored record by transmitting the data rapidly.

In an embodiment a point of recordation terminal apparatus comprises:

- a high resolution digital camera,
- a first storage device,
- a first network interface,
- a circuit controlled by software to signal a motion threshold,
- a circuit controlled by software to measure motion activity,
- a circuit controlled by software to track motion objects with analysis artifacts,
- a circuit controlled by software to encode h.264 format files,
- a circuit controlled by software to encode JPEG files,
- a circuit to write to flash memories (as non-limiting example an SD card),
- a circuit to generate small reference images, timestamps, motion and asset meta-data,
- a circuit controlled by software to determine if multiple events of interest occur in close proximity,
- a circuit controlled by software to cause a single extent of data to be recorded indicative of multiple event representations and where they occur,
- a circuit controlled by software to store assets locally on the first storage device and to retry transmission at a later time wherein
- a circuit comprises a processor controlled by software instructions and the processor is coupled to the first network interface, the processor is coupled to the first storage device, and the processor is coupled to the high resolution digital camera.

In an embodiment of the invention, a PORT further comprises a policy store, the policy store coupled to the connection manager, a formatting circuit, the formatting circuit coupled to the policy store, to the archive store, to the upload manager, and to the bandwidth controller and to the video encoding circuit. In an embodiment of the invention, a PORT further comprises an upload manager circuit coupled to the archive store and to the policy store, and to the bandwidth controller. In an embodiment of the invention, a PORT further

US 8,558,888 B2

13

comprises a connection manager coupled to a policy store and coupled to the network interface.

In embodiments of the invention, a PORT further comprises at least one of a policy store, a connection manager, a formatting circuit, and an upload manager. The policy store is coupled to the connection manager, the formatting circuit, the upload manager, the bandwidth controller, and the asset and event capture circuit. The formatting circuit is further coupled to the video encoding circuit, to the archive store, to the bandwidth controller. The upload manager circuit is further coupled to the archive store, and to the bandwidth controller. The connection manager is further coupled to the bandwidth controller and to the network interface. Therefore, policies which determine actions upon certain conditions are received from the network by the connection manager and stored to the policy store whereby the upload manager circuit determines which and how quickly assets are transmitted via the bandwidth controller and the network interface, whereby the formatting circuit determines how to convert raw video to streamable video and how to determine the preroll and post roll parameters, whereby the connection manager changes the operating mode upon certain conditions specified in a policy stored in the policy store.

In an embodiment, a PORT provides metadata captured outside of events of interest which represents the basic inputs to the event of interest determining circuit. In an embodiment a PORT periodically uploads this information as it is generated. The upload of this information allows a POA to analyze the PORT configuration to determine if some other configuration would better capture appropriate events of interest. The periodic upload allows the POA to determine the basic operational status of a connected PORT.

A bandwidth controller circuit executes a first bandwidth management policy for the upload of references and a second bandwidth management policy for the upload of assets. Different modes distinguish “real time” and the recovery mode. The bandwidth controller circuit implements retention policies for both on camera assets, and on camera references. In an embodiment, if a camera runs out of space, the bandwidth controller circuit determines what to throw away (in an embodiment it throws away complete asset sets for oldest events), but it can do other things—throwing away “snapshots” but keeping the video for example.

In an embodiment a bandwidth controller is set to one of several policies in the event of losing network connectivity, such as the non-limiting exemplary policies: storing for recovery and just discarding. A service provider offers additional capacity at incremental pricing. In an embodiment the PORT self regulates its uploading of an asset according to its embedded policy. In an embodiment a server removes bandwidth limitation for a specific asset (and no other transfer) and demands that asset be uploaded without delay. Accordingly, the PORT records such a demand upload and removes it from the queue of assets remaining.

In an embodiment, a PORT receives a policy conditioned on whether a camera has storage available and on whether services have been selected for subscription. Specifically an SD card slot in the camera enables bandwidth shaping. In an embodiment data on the SD card is independently available without decryption. In an embodiment data on the card is stored encrypted.

In an embodiment, the bandwidth controller is a processor controlled by software for policy management for to determine when to upload and how much. In an embodiment it utilizes time-of-day (e.g. don’t contend for internet connection when customers are using wi-fi service, but change bandwidth limits after midnight). In an embodiment it utilizes

14

reliability measurements (if packet loss on the link exceeds a threshold, back off sending for a random or fixed time amount to reduce contention). In an embodiment the bandwidth controller circuit utilizes pricing models to determine when to upload and how much (e.g. if unlimited connectivity on my wireless plan after 7, only send references then). In an embodiment, a set of PORTs are organized as a group and bandwidth policy is managed among the group.

An apparatus for generating and storing an asset comprises a digital camera coupled to video memory, the memory coupled to an archive store such as a removable SD flash memory card, and a processor coupled to all the above and to a network interface card.

One means for reading and encoding a camera identification is a processor encoded with a PrettyGoodPrivacy strong encryption algorithm and a private key. One means for reading and encoding a time of day of the asset is reading Unix time from an internet server at the time the first video frame is captured by a digital camera attached to a processor. One means for selecting and storing at least one high resolution digital photograph is a motion detection circuit coupled to a memory configured as a pipeline coupled to a digital camera. Another means is comparing each digital camera frame to a reference frame and capturing a frame having a number of pixels above a threshold different from the reference frame. One means for deriving and storing a medium resolution video image sequence is a jpeg or mpeg chip coupled to a video memory and writing to a flash memory. One means for reading and encoding at least one offset of at least one high resolution digital photograph relative to the time of day of the asset is subtracting the time of the start of the asset from the time at the threshold crossing frame.

The apparatus comprises a circuit coupled to a video memory and writing an asset to a flash memory wherein the asset is an encrypted digital file.

One means for determining and encoding a type of event is reading from the threshold circuit comparing a reference frame to a video frame the parameters of difference. One means for computing and storing a digital signature is encoding a processor with a PrettyGoodPrivacy algorithm and combining a private key, the time of day of the asset, and the size of the asset or reference. One means for determining and storing a preroll before the start of the event is counting the stages of a pipeline memory from the entrance until the point that an event has been determined. One means for determining and storing a postroll after the end of the event is adding a fixed value to the time of the end of the event.

The apparatus comprises a processor adapted to read a video memory and generate a reference which is an encrypted digital file.

One means for deriving a low resolution, scaled still image is encoding a processor with a JPEG algorithm, reducing the scale of a photograph to less than 100×100 pixels, and setting the JPEG algorithm to low resolution. One means for reading and storing a size of the asset is instructing a processor to read the file header from the flash memory controller.

One means for deriving meta-data values includes a processor reading output values from a circuit for graphics processing coupled to a video memory.

Said means comprises a circuit comprising a processor coupled to computer-readable media encoded with instructions for computing meta-data values, determining the size of an asset, determining an event, selecting a high resolution digital photograph from an image sequence, converting an image sequence into a medium resolution video image sequence, deriving a compressed, scaled, low resolution representation from a selected high resolution digital photo-

US 8,558,888 B2

15

graph, reading camera identification and computing a digital signature, wherein a reference comprises a plurality of digital files encoded by strong encryption.

Means for reading and encoding a PORT identification include a processor encoded to perform a digital signature on an encoded image using a private key unique to the PORT.

Means for generating a PORT unique identification for the asset include a processor encoded to increment an event number, or encode the time and date of the event.

Means for generating multiple representations of the event include a processor encoded to:

include an encoded video representation of an image sequence representative of the event,

wherein an image sequence representative of an event includes images from immediately before the event of interest,

wherein an image sequence includes image from immediately after the event of interest;

to indicate the relative activity detected in each image of the sequence;

to include data derived from analysis of the event of interest;

to include an encoded high resolution image of an image representative of the event;

to reference two grouping of representations, one optimized for minimizing the number of bytes required and one optimized to accurately represent the event of interest;

to identify two groups associated by the unique identifier, wherein one of the two groups provides indication of the exact representations in the available in accurate representation,

wherein one of the two groups includes size, relationship, and type indication; and

to combine representations into a single larger group if two events of interest occur sufficiently close in time that events immediately before or after would overlap.

Means for indicating the timing relationship between different representations include a processor encoded to:

record the sequence number of the image from the start of the representation, or

record the time and data of the representation.

An apparatus is disclosed comprising a digital camera coupled to a formatting circuit coupled to an encryption circuit coupled to an archive store, wherein the encryption circuit comprises an input for reading a unique camera identification key, an input for reading a video stream from the formatting circuit, a processor for encoding the video stream with time, date, and the unique camera identification key, and an output for writing the resultant encoded video stream to the archive store.

An apparatus is disclosed comprising a digital camera coupled to a reference select & meta-tagger circuit coupled to a formatting circuit coupled to a connection manager circuit coupled to a network interface, wherein the connection manager circuit comprises a processor controlled by software to perform the following operations: reading a destination IP address hardcoded onto the connection manager circuit board, receiving a compact representation of an event of interest from the reference select & meta-tagger circuit, preparing packets with the destination IP address containing the compact representation, opening a client session with the destination IP address, and transmitting the packet as a client to a server at the destination IP address.

A point of recordation terminal apparatus is disclosed comprising:

16

a network interface, the network interface coupled to a network;

an asset & event capture circuit;

a reference selection & meta-tagger circuit;

a bandwidth controller circuit; and

an encryption circuit, whereby captured assets and references are encrypted prior to transmission.

The apparatus further comprises an archive store coupled to the encryption circuit whereby captured assets and references are stored in encrypted form into the archive store.

The encryption circuit is uniquely associated with the specific PORT by cryptographic operation. The encryption circuit indicates the time and date of the event of interest by cryptographic operation on the assets.

A method is disclosed comprising transmitting a reference immediately while storing an asset into the archive store. The method further comprises temporarily storing the transmitted reference and storing it to the archive store in case the transmission fails.

By storing is meant the steps of detecting when the transmission is likely to be possible again and retransmitting the reference.

A point of recordation terminal apparatus is disclosed comprising:

a network interface, the network interface coupled to a network;

an asset & event capture circuit;

a reference selection & meta-tagger circuit;

wherein the network interface comprises a configuration detection circuit whereby it automatically detects and configures its network interface settings.

A method of operating the configuration detection circuit is disclosed comprising sequentially trying the following processes until a working configuration is established: DHCP, static configuration and auto-detection, wherein auto-detection comprises

determining the local addressing scheme;

selecting a host address not detected in the local network, probing the selected address to determine if used, and reselecting if collision is detected; and

sending a prospective transaction on at least one port to each identified hosts on the local network to determine if any act as a gateway, and selecting a host as a gateway if successful.

In an embodiment, determining the local addressing scheme comprises passively listening to network traffic to determine the local addressing scheme and hosts on the networks. In an embodiment, determining the local addressing scheme comprises actively probing the network to determine the local addressing and hosts on the local network.

A point of recordation terminal apparatus is disclosed comprising

a network interface, the network interface coupled to a network;

an asset & event capture circuit;

a reference selection & meta-tagger circuit; and

a connection manager circuit, whereby the connection manager and the network interface establish client sessions to a server at a known location.

Methods of operating the apparatus include without limitation the following independent processes:

establishing an HTTP or HTTPS protocol client session.

receiving commands issued by a server responding to a client.

periodically reestablishing its client connection to a server.

processing a command to quickly reestablish a client connection.

US 8,558,888 B2

17

providing status indication for commands currently running in a client connection and for commands recently completed in a client connection; and other methods for operating the apparatus known in the art.

CONCLUSION

The present invention is distinguished from conventional video surveillance systems by using a public network enabled by its bandwidth controller and encryption circuits, by providing for low bandwidth reference transmission in near real time while queuing multi-frame assets for policy controlled transmission, and policy controlled bandwidth control in response to recovery, normal operation, streaming, and searching.

The present invention is distinguished from conventional cameras by determining if motion has occurred within a period, creating at least one reference indicative of the motion, transmitting the references in real time, and only storing, analyzing, or uploading data around times of motion to reduce bandwidth consumption. In particular, the invention allows efficient and secure use of cloud computing. By encrypting assets and references on a per PORT and per user basis and not decrypting them during upload and storage, the security and providence of the data is assured even when using resources shared across many different companies. The PORT is distinguished from convention video cameras by using only outbound network connections compatible with a wide area network to establish connection with a POA. It is particularly pointed out and distinctly claimed that a network can connect using a cellular network as the back haul as the disclosed bandwidth utilization model makes it practical and affordable (since cellular bandwidth is very expensive compared to landline/wi-fi).

Significantly, this invention can be embodied in other specific forms without departing from the spirit or essential attributes thereof, and accordingly, reference should be had to the following claims, rather than to the foregoing specification, as indicating the scope of the invention.

What is claimed is:

1. A method for operating an apparatus for to reliably maintain high complexity continuous data over a low bandwidth and unreliable connection, the apparatus comprising: a point of recordation terminal (PORT) coupled to a connection, the method comprising capturing, and transmitting, an event of interest, wherein capturing an event of interest comprises the following processes: determining when an event of interest occurs; selecting an extent of data associated with the event of interest; efficiently recording the selected extent of data; deriving a compact representation of the event of interest; and storing the recorded events; wherein transmitting an event of interest comprises the following processes: transmitting immediately when directed and storing if immediate transmission fails; opening an https client session; opening an https server session; connecting between an https client and server; transmitting with link level encryption; storing recorded events of interest locally; and transmitting when an acceptable amount of bandwidth becomes available.

18

2. A point of recordation terminal comprising:

a high resolution digital camera;
a first storage device;
a first network interface;
a circuit controlled by software to signal a motion threshold;
a circuit controlled by software to measure motion activity;
a circuit controlled by software to track motion objects with analysis artifacts;
a circuit controlled by software to encode h(dot)264 format files;
a circuit controlled by software to encode JPEG files;
a circuit to write to non-volatile removable memories;
a circuit to generate thumbs, timestamps, and motion meta-data;
a circuit controlled by software to determine if multiple events of interest occur in close proximity;
a circuit controlled by software to cause a single extent of data to be recorded indicative of multiple event representations and where they occur; and
a circuit controlled by software to store assets locally on the first storage device and to retry transmission at a later time wherein a circuit comprises a processor controlled by software instructions and the processor is coupled to the first network interface, the processor is coupled to the first storage device, and the processor is coupled to the high resolution digital camera.

3. An apparatus comprising:

a point of recordation terminal (PORT) coupled to a connection, said PORT comprising:
an asset & event capture circuit;
a reference select & meta-tagger circuit;
a formatting circuit;
an archive store;
a network interface;
a bandwidth control circuit;
an upload management circuit;
an encryption circuit;
a connection management circuit; the reference select & meta-tagger circuit coupled to the asset and event capture circuit and coupled to the formatting circuit, the archive store coupled to the formatting circuit and to the upload management circuit, the encrypt circuit coupled to the formatting circuit and to the archive store, the network interface coupled to the connection management circuit and to the bandwidth control circuit;
a policy store, the policy store coupled to the connection management circuit, the policy store coupled to the bandwidth control circuit, the policy store coupled to the asset & event capture circuit, the policy store coupled to the reference select & meta-tagger circuit, and the policy store coupled to the upload management circuit.

4. A method for operating an apparatus for to reliably maintain high complexity continuous data over a low bandwidth and unreliable connection, the apparatus comprising:

a point of recordation terminal (PORT) coupled to a connection, the method comprising:
capturing an event of interest, wherein capturing an event of interest comprises the following processes:
determining a start of an event of interest;
recording data associated with the event of interest;
deriving a compact representation of the event of interest;
recording the compact representation of the event of interest;
determining an end of the event of interest;
stopping recording data;

US 8,558,888 B2

19

transmitting an event of interest, wherein transmitting an event of interest comprises the following processes:
 opening a client session to a server;
 transmitting the recorded compact representation of the event immediately; and
 storing recorded events of interest locally for later transmission; wherein capturing an event of interest further comprises:
 reading a policy from a policy store;
 determining the triggers which cause certain actions and when triggered;
 setting thresholds for event determination;
 selecting data for association with an event of interest to be recorded;
 setting parameters for deriving a compact representation; and
 setting resolutions for deriving compact representation.

5. A method for operating an apparatus for to reliably maintain high complexity continuous data over a low bandwidth and unreliable connection, the apparatus comprising: a point of recordation terminal (PORT) coupled to a connection, the method comprising:
 capturing an event of interest, wherein capturing an event of interest comprises the following processes:
 determining a start of an event of interest;
 recording data associated with the event of interest;
 deriving a compact representation of the event of interest;
 recording the compact representation of the event of interest;
 determining an end of the event of interest;
 stopping recording data;
 transmitting an event of interest wherein transmitting an event of interest comprises the following processes:
 opening a client session to a server;
 transmitting the recorded compact representation of the event immediately; and
 storing recorded events of interest locally for later transmission; wherein transmitting the recorded compact representation of the event comprises the steps following:

20

storing the compact representation of the event in the archive store of the PORT for later transmission if immediate transmission fails and
 detecting that immediate transmission has failed.

6. The method of claim 5 wherein transmitting further comprises:
 reading a policy from a policy store;
 determining the triggers which cause certain actions and when triggered;
 setting a rate for immediate transmission;
 setting a rate for later transmission;
 initiating an upload of a specific recorded event; and
 overwriting stored recorded events with new recorded events or discarding new recorded events.

7. The method of claim 6 further comprising:
 transmitting accumulated compact representations from the archive store of the PORT; and
 detecting when connectivity has been restored.

8. The method of claim 7 wherein transmitting accumulated compact representations comprises:
 transmitting accumulated recorded compact representations at a limited rate determined by reading a policy store.

9. An apparatus comprising:
 a digital camera coupled to
 a reference select & meta-tagger circuit coupled to
 a formatting circuit coupled to
 a connection manager circuit coupled to
 a network interface, wherein the connection manager circuit comprises a processor controlled by software to perform the following operations:
 reading a destination Internet Protocol (IP) address hardcoded onto the connection manager circuit board;
 receiving a compact representation of an event of interest from the reference select & meta-tagger circuit;
 preparing packets with the destination IP address containing the compact representation;
 opening a client session with the destination IP address; and
 transmitting the packet as a client to a server at the destination IP address.

* * * * *

Exhibit B

to

Complaint for Patent Infringement

The '069 Patent



US009472069B2

(12) **United States Patent**
Roskowski

(10) **Patent No.:** **US 9,472,069 B2**

(45) **Date of Patent:** **Oct. 18, 2016**

(54) **DETECTING, RECORDING, ENCRYPTING
AND UPLOADING REPRESENTATIONS OF
EVENTS OF INTEREST VIA A SINGLE
POINT OF RECORDATION TERMINAL
(PORT)**

(2013.01); *H04N 7/181* (2013.01); *G08B*
13/19602 (2013.01); *G08B 13/19665*
(2013.01); *H04N 5/23206* (2013.01)

(58) **Field of Classification Search**

CPC *G08B 13/19602*; *G06B 13/19665*;
H04N 7/181
USPC 348/142, 143
See application file for complete search history.

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(73) Assignee: **BARRACUDA NETWORKS, INC.**,
Campbell, CA (US)

(*) Notice: Subject to any disclaimer, the term of this
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U.S.C. 154(b) by 335 days.

(21) Appl. No.: **13/666,879**

(22) Filed: **Nov. 1, 2012**

(65) **Prior Publication Data**

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Related U.S. Application Data

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27, 2009, now Pat. No. 8,558,888.

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G08B 13/196 (2006.01)
H04N 5/76 (2006.01)
H04N 5/232 (2006.01)

(52) **U.S. Cl.**
CPC *G08B 13/196* (2013.01); *H04N 5/76*

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,104,428 A *	8/2000	Lu et al.	348/159
7,131,136 B2 *	10/2006	Monroe	725/105
7,236,690 B2 *	6/2007	Matsukawa	386/223
2003/0044168 A1 *	3/2003	Matsukawa	386/117
2014/0105388 A1 *	4/2014	Jung et al.	380/45
2015/0016269 A1 *	1/2015	Ramchandran	370/241

* cited by examiner

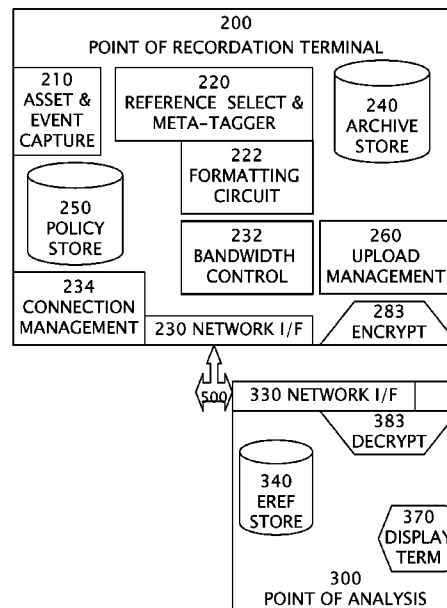
Primary Examiner — Mohamed Wasel

(74) Attorney, Agent, or Firm — Duane Morris LLP;
David T. Xue

(57) **ABSTRACT**

A single Point of Recordation Terminal (PORT) is disclosed. The PORT is configured to detect one or more events of interest, generate one or more representations of the event and establish the timing relationship among the multiple representations of the event of interest. The PORT is further configured to associate a unique ID of the PORT with the representations, encrypt and upload the representations to the cloud.

20 Claims, 8 Drawing Sheets



U.S. Patent

Oct. 18, 2016

Sheet 1 of 8

US 9,472,069 B2

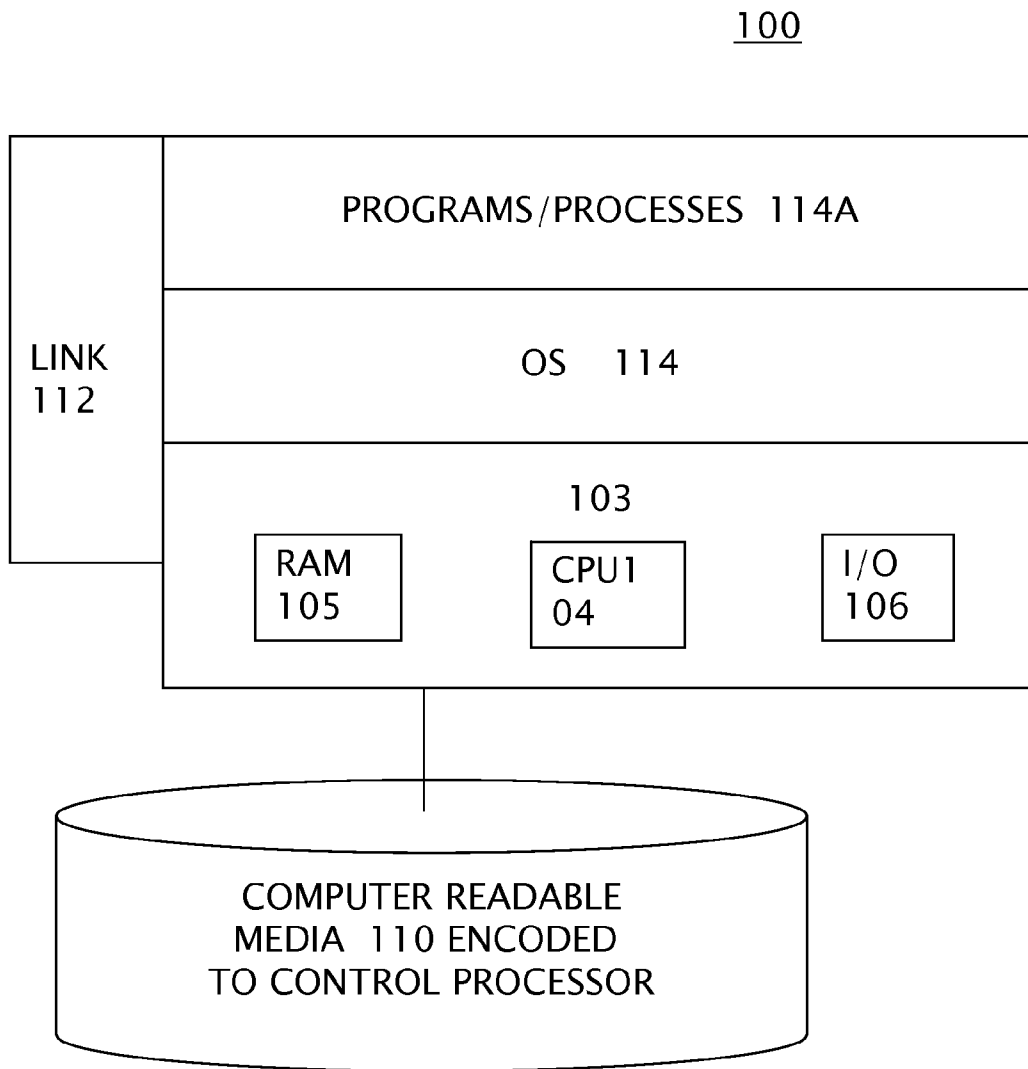


FIG. 1

U.S. Patent

Oct. 18, 2016

Sheet 2 of 8

US 9,472,069 B2

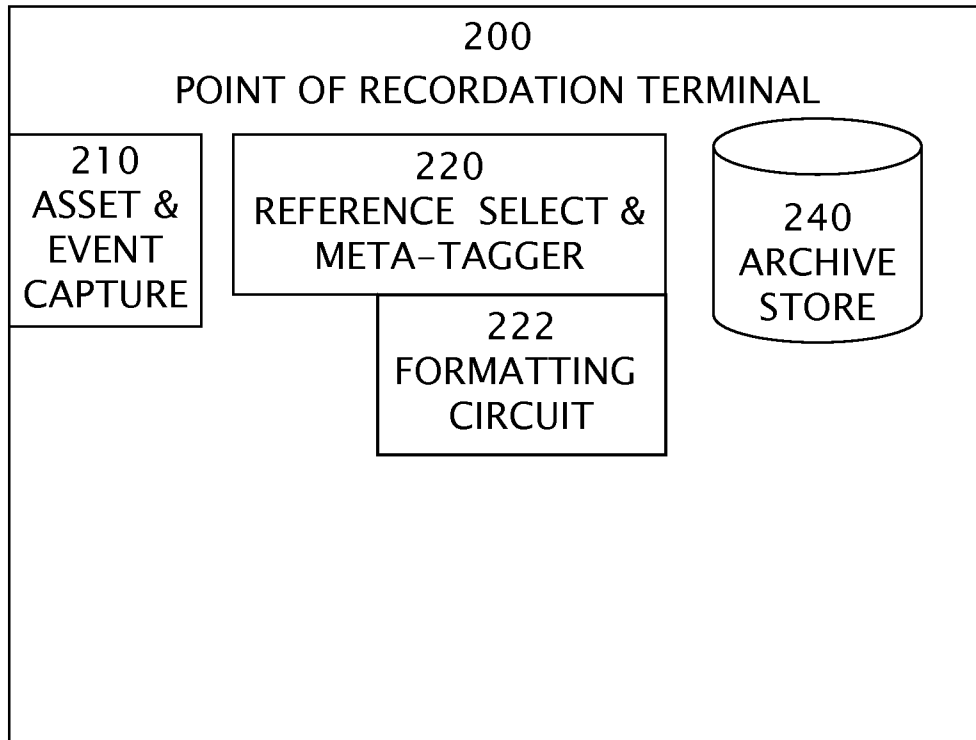


FIG. 2

U.S. Patent

Oct. 18, 2016

Sheet 3 of 8

US 9,472,069 B2

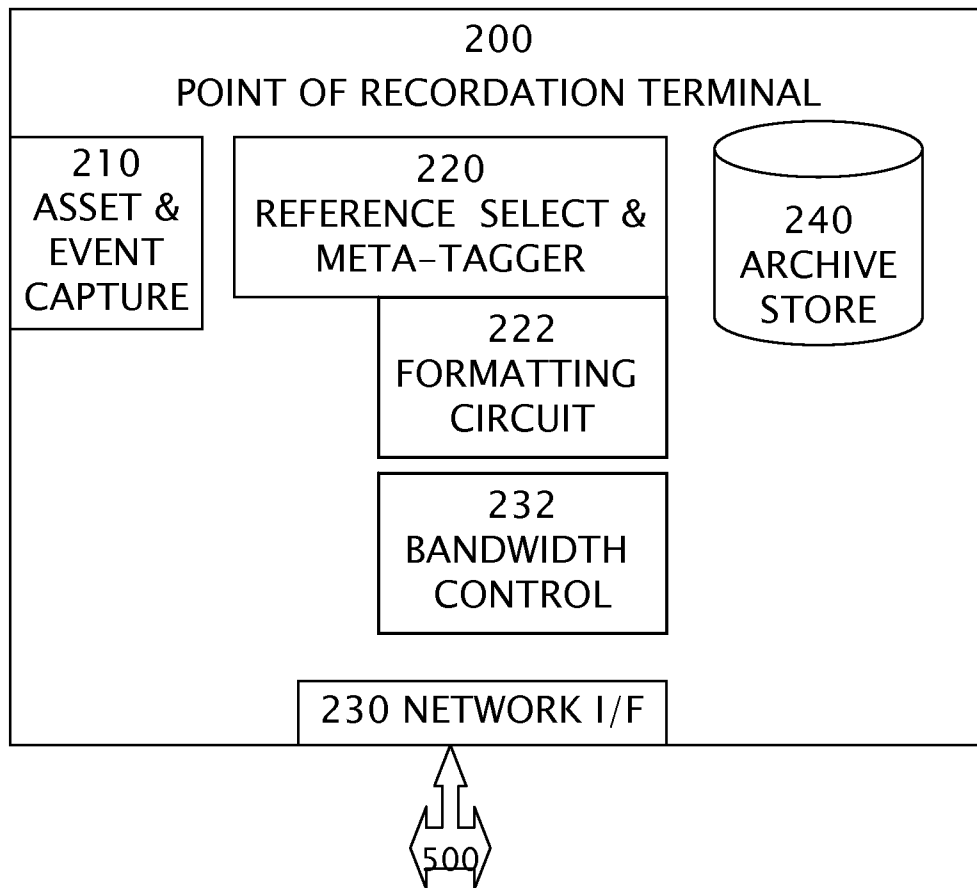


FIG. 3

U.S. Patent

Oct. 18, 2016

Sheet 4 of 8

US 9,472,069 B2

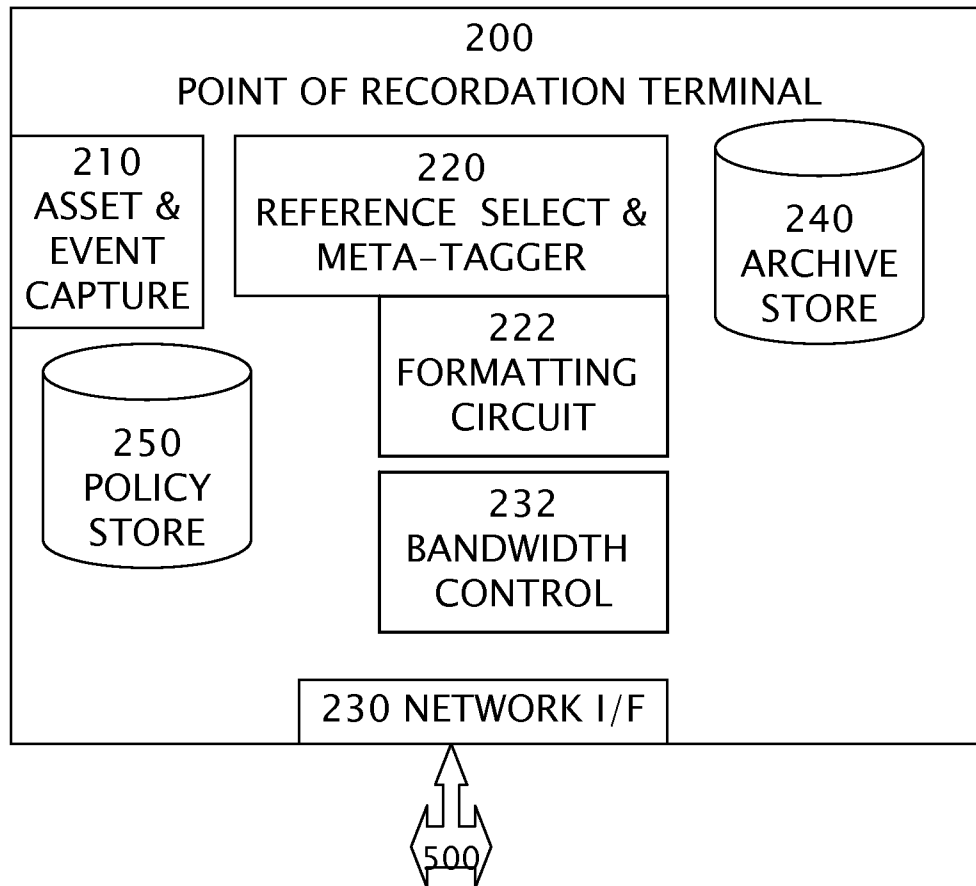


FIG. 4

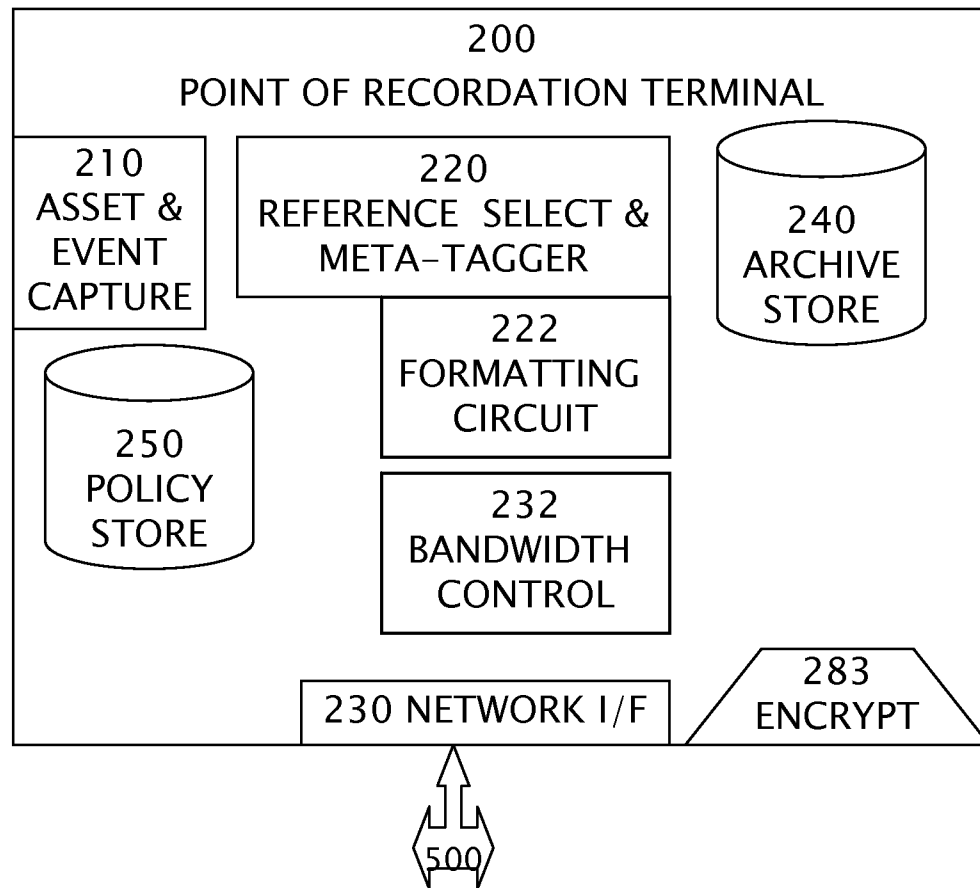


FIG. 5

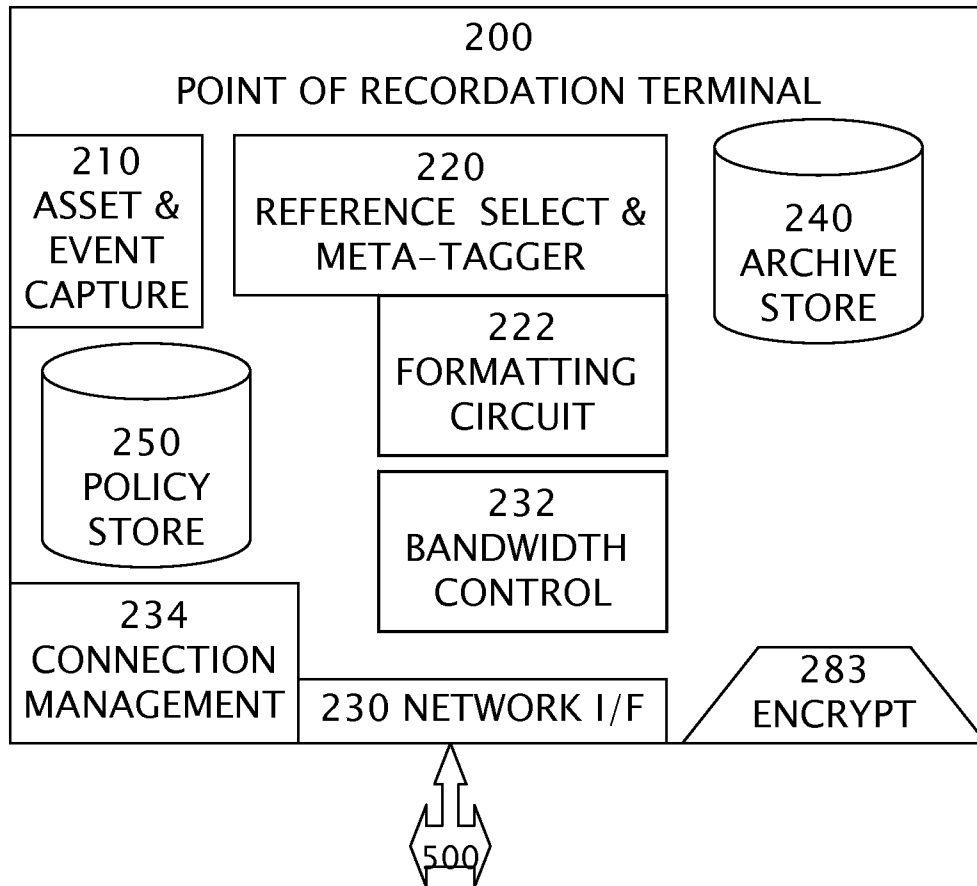


FIG. 6

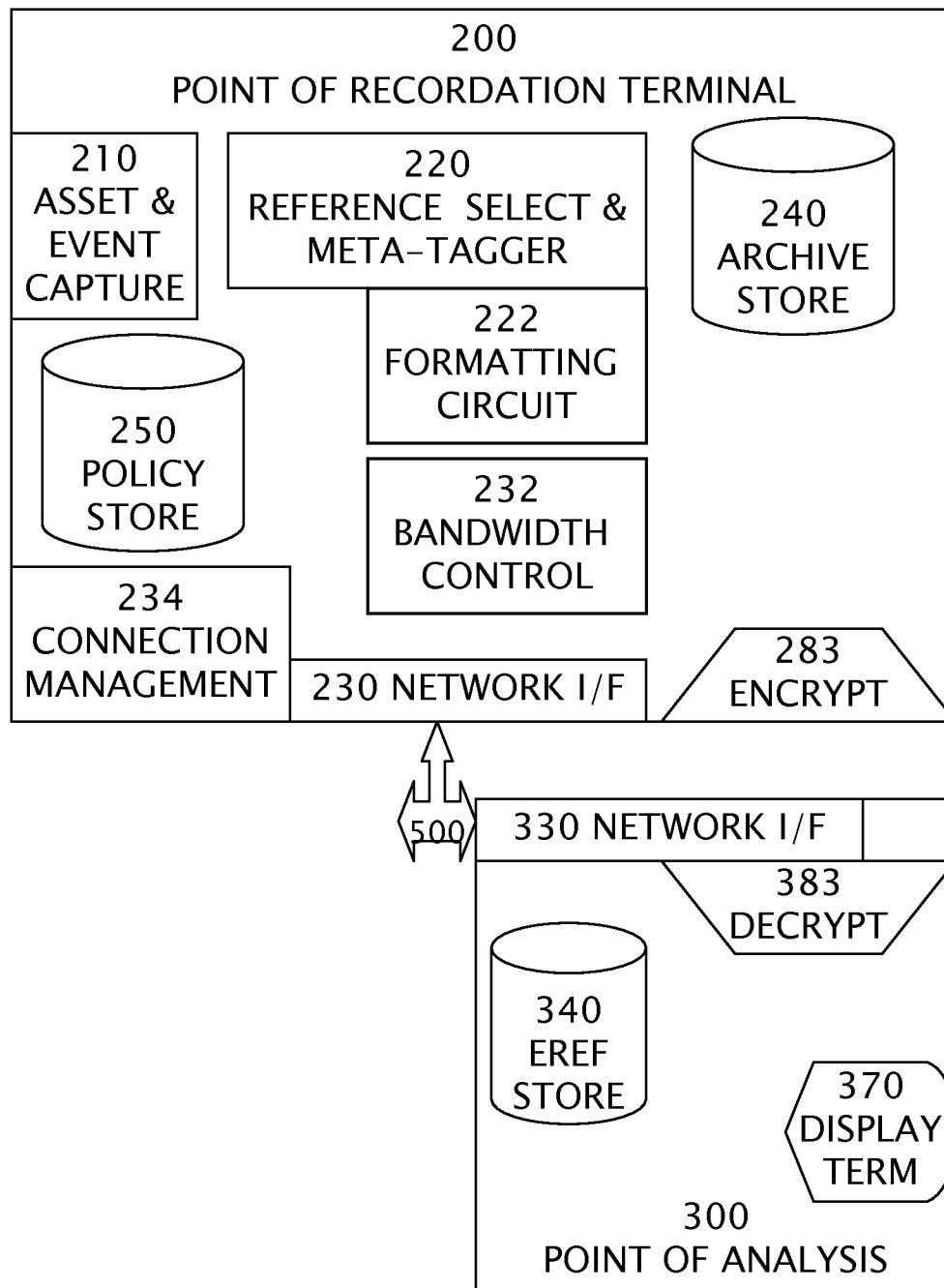


FIG. 7

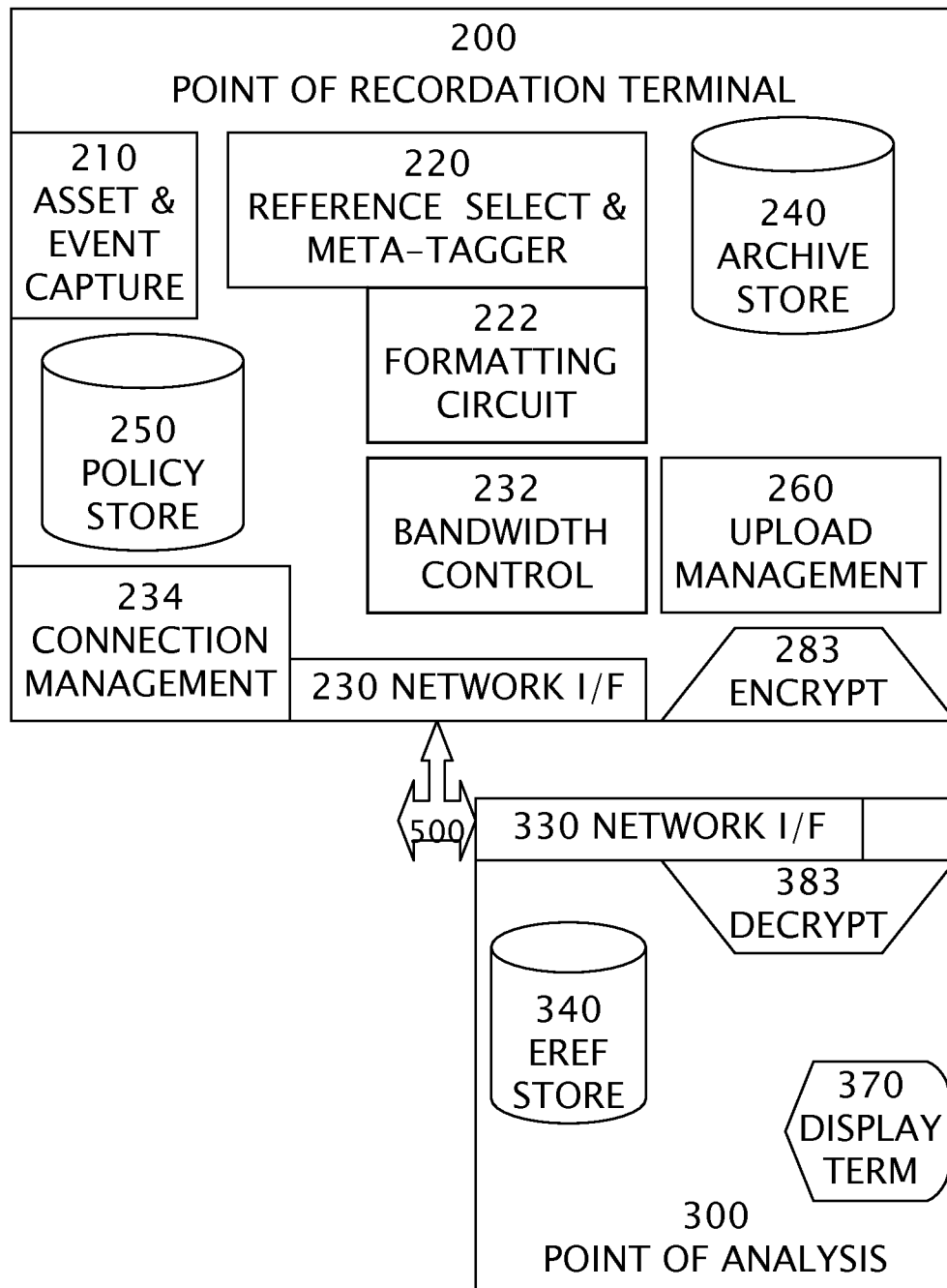


FIG. 8

US 9,472,069 B2

1

**DETECTING, RECORDING, ENCRYPTING
AND UPLOADING REPRESENTATIONS OF
EVENTS OF INTEREST VIA A SINGLE
POINT OF RECORDATION TERMINAL
(PORT)**

This application is a division of pending application Ser. No. 12/395,437 filed Feb. 27, 2009 and claims the benefit of the prior-filed application under 35 U.S.C. 120, 121, or 365(c)e.

BACKGROUND

Security cameras are increasingly important for both enterprises and consumers. All levels of government are promoting installation of cameras to address fears of crime. Liability insurers may raise rates on customers who cannot document that their premises are controlled. But the market is bifurcated into extremely costly high end integrated services and low cost do-it-yourself system design projects for hobbyists. By high complexity image sequences the present invention includes high resolution digital photographs, lower resolution moving images in the form of a series of video frames, meta-data about the time, place, and conditions of the image, and derived data from quantitative metrics of the images and compressed low resolution extracts from images. Internet Protocol (IP) network digital cameras are known as an accepted solution for security and monitoring. Utilizing IP networks instead of dedicated video connections to a local server dramatically improves system flexibility and can reduce connectivity and management complexity.

Conventional IP network camera system design requires "logging in" to each camera. Typically, each camera implements a website for user access. After a user connects to a camera, he or she may then view data, configure the camera, control conventional camera pan, tilt, and zoom (PTZ) functions, or view a real time stream of image data. In common applications, people also want to record the video to allow an analysis of events either missed in real time or not observed with the necessary attention.

Conventional cameras can be configured to send an email including images when an event happens. Conventional cameras can be configured to broadcast or stream video. Conventional cameras can be configured to perform a file transfer protocol (FTP) transaction, in a non-limiting example, uploading at least one image. While this is closer to a desired end user functionality, conventional implementations require extensive network application and system engineering and only result in transfer of limited amounts of information. For example it is observed by the inventors that configuration of each network environment consists at least of opening ports, mapping addresses, managing a difficult maintenance and operations model to be assured that the system is working when needed, and addressing security concerns. For example, is the equipment on premises vulnerable to theft or damage, can end users properly configure the network and the specific camera device, what steps are needed to easily record and analyze the video.

To allow live access to cameras, a user should be able to configure firewalls if external access is to be allowed and to configure an IP address resolution service such as a dynamic DNS application. Because the solution depends on an occasional user to define and configure each security installation, deployed solutions have been known to exhibit very poor security such as unintended publicly viewable webcams.

2

It is known that configuring for recording video is even more complex than simply viewing it. The typical solution requires selecting and installing an additional system into the user's local network to record the video, configuring the cameras to transmit incoming data in a manner compatible with the recording system, and assuring all network configurations are correct to allow reliable communication between cameras and recording systems. This introduces additional hardware to be configured and maintained. It creates an additional exposure for assets to be stolen or damaged. Prior to beginning the installation, users must determine how large and complex a system they will ultimately require or some procurement will turn out to be inadequate and soon obsolete.

To utilize outbound FTP functionality, the user of conventional systems must configure a server to accept the FTP transactions and configure the camera to upload the data appropriately. Further, since the FTP transaction is typically not in real time, the size is limited by the amount of memory available for storage on the device. Alternately an email solution can be considered. Unfortunately, e-mail cannot typically provide true video recording. Limitations of email servers and email accounts constrain the email alert model to only a few images. Further, since email does not enable realtime streaming of data to the email server, the total size of the stored video is limited to the storage on the device.

Conventional video security systems do not enable proactive monitoring of their status. End users occasionally discover when an event occurs in their premises, that their system was not functioning correctly and that they do not have the desired critical information despite having made investments into both cameras and recording systems. Since video monitoring systems are typically not core to the business of most enterprises, but supportive, the resources allocated to maintain the system are frequently inadequate, insufficient, or lack the proper expertise to maintain the system effectively. This results in many video systems being effectively turned off after a period of time as the cost and complexity of maintaining the system overwhelms the day to day benefits. Only the largest governmental or private enterprises have continuous human monitoring of all cameras.

The challenge of maintaining operational systems has been addressed in other domains effectively by adopting a "service model" where minimal equipment is onsite and a centralized service provides functionality to a large pool of users. Video monitoring has historically been unable to use this model effectively due to the high bandwidth required to effectively record usable quality video. While this bandwidth can be addressed in local area networks, a service model with centralized recording requires video to be sent over a wide area network such as the Internet, and such connection may be costly and typically limited. For example many business have traditionally had "T1" connectivity, which is bidirectional at about 1 megabit per second. A single camera with high quality video in traditional implementations uses 2-3 megabits of bandwidth, making a conventional service based model impractical.

The benefits of a service based model would be significant. One key benefit is the ability to use shared resources across a larger number of customers. This amortizes the cost of equipment, monitoring and maintenance, allowing very high levels of service at manageable costs. In the area of equipment and management, it is known a single logical storage volume, potentially made up of a very large number of physical volumes, can be shared amongst a large number of users if there are sufficient safeguards for privacy. Using

US 9,472,069 B2

3

a single large logical storage volume allows for significant individual variance in usage patterns to be efficiently addressed. A single large logical storage volume also allows additional reliability and maintenance investments to be amortized over the entire user set, significantly increasing reliability and reducing costs.

Similarly it is known that a set of processing elements can be efficiently shared amongst a plurality of sporadic processing demands. The virtual machine model is one well known implementation that allows processing to be allocated and de-allocated to processing resources on demand. Several other processing models are known ways of distributing computational demands over a large number of processing elements. The models include pipelining, where a single processing element performs a small part of the overall function for multiple processing demands, and threading, where a single process is divided into multiple logical subprocesses.

These processing and storage models have been optimized in a computational architecture commonly called "cloud computing". In cloud computing a very large number of machines and a very large amount of logical storage is made available in an on-demand basis to a large body of customers. Customers can increase and decrease the amount of computational resources allocated to them on a demand basis. Each computation resource is some version of a virtual machine, which can then be further partitioned into individual user computation needs as outlined above. Cloud computing also provides cloud storage, where a very large amount of storage is made available on a demand basis, allowing customers to allocate and de-allocate storage as needed. One example of cloud computing is Amazon's Elastic Computing Cloud (EC2). One example of cloud storage is Amazon's Simple Storage Service (S3).

The following processes are known in the art as methods for motion detection: processing a constant sequence of images (video), establishing a reference image of the scene with only background items, detecting when pixels are changed sufficiently in subsequent images to indicate areas in motion, counting the number of pixels in motion to determine if enough have changed to indicate an event of interest, and updating the background image for areas that have changed minimally. Significant improvements are known on this basic algorithm including object detection and object recognition. Thus it can be appreciated that what is needed is an apparatus which makes deployment, maintenance, and operation of IP network cameras much less complex. What is needed is equipment that is extremely easy to set up and maintain by using a cloud computing infrastructure and strategy.

SUMMARY OF THE INVENTION

A novel implementation of a security camera, is a Point of Recordation Terminal (PORT) apparatus disclosed as follows. In use, a plurality of point of recordation terminals (PORTs) are distributed among small and medium sized enterprises for installation in their respective private networks. Each PORT captures and analyzes images to determine if there is an event of interest. Events of interest are compressed, formatted and stored to construct an asset. A reference to each asset is transmitted in near real-time comprising a compressed single frame, time, date, meta-data associated with the assets not transmitted and identity of the terminal. The reference provides sufficient information to uniquely access the associated asset on the specific PORT.

4

The PORT provides a mechanism for a Point of Analysis (POA) apparatus to access the associated asset at a later time if desired.

The method for defining an event of interest results in identification of a sequence of images which span the event of interest. In an embodiment the sequence of images is compressed with a video compressor circuit to create the video asset. In an embodiment, some images can be stored in anticipation of the beginning of a event of interest, keeping a constant record of the last several images. This sequence of images is provided to the compression circuit before the images associated with the event of interest, providing a short "preroll" of video of the images leading up to the event of interest. In an embodiment, the sequence of images provided to the compressor circuit can be continued after the end of the event of interest to provide a "postroll" of video of images after the event of interest.

The PORT comprises a bandwidth controller circuit which regulates the archiving, purging and transmission of assets and references under direction of a plurality of policies. Policies are selected based on a plurality of conditions including PORT application, date and time, configured bandwidth utilization, PORT status, and network connectivity status. A mechanism is provided to allow the POA to change policies and policy selection criteria. The PORT contains unique identification information to allow it to be securely and unquestionably associated with certain resources on the POA. The PORT also comprises a means for encrypting and signing assets and references independent of data transport allowing a POA to securely maintain the uploaded content and to validate with a high degree of confidence the providence of the assets transmitted from the PORT.

The PORT comprises means for automatically determining its network environment and contacting the POA with minimal or no user configuration. The PORT utilizes only data connection initiated by the PORT to a known location for the POA to function in any local network without user configuration of the PORT or the local network environment. One means is a processor controlled by software to perform network exploration and self-configuration as disclosed below.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a processor adapted to perform as a circuit according to the present invention.

FIG. 2-8 are block diagrams of a point of recordation terminal embodiments.

DETAILED DESCRIPTION OF EMBODIMENTS

The embodiments discussed herein are illustrative of one example of the present invention. As these embodiments of the present invention are described with reference to illustrations, various modifications or adaptations of the methods and/or specific structures described may become apparent to those skilled in the art. All such modifications, adaptations, or variations that rely upon the teachings of the present invention, and through which these teachings have advanced the art, are considered to be within the scope of the present invention. Hence, these descriptions and drawings should not be considered in a limiting sense, as it is understood that the present invention is in no way limited to only the embodiments illustrated.

In embodiments of the invention there are circuits for encrypting video frames at the point of recordation terminal

US 9,472,069 B2

5

(PORT) apparatus. In an embodiment references, assets, or both are encrypted before storage. In an embodiment references, assets, or both are encrypted before transmission through a public network.

FIG. 1 shows a block diagram of a typical computing apparatus 100 where the preferred embodiment of this invention can be practiced. The computer apparatus 100 includes a computer platform having a hardware unit 103, that implements the methods disclosed below. The hardware unit 103 typically includes one or more central processing units (CPUs) 104, a memory 105 that may include a random access memory (RAM), and an input/output (I/O) interface 106. Various peripheral components such as a camera may be connected to the computer platform 102. Typically provided peripheral components include a data storage device (e.g. flash, or disk) 110 where the policies and images used by the preferred embodiment is stored. A link 112 provides access to the global Internet. An operating system (OS) 114 coordinates the operation of the various components of the computer system 100, and is also responsible for managing various objects and files, and for recording certain information regarding same. Lying above the OS 114 is a software layer 114A. The user layer 114A runs above the operating system and enables the execution of programs using the methods known to the art and is where most processing as described typically occurs.

An example of a suitable CPU is a Xeon™ processor (trademark of the Intel Corporation); examples of an operating systems is Wind River RTOS. Those skilled in the art will realize that one could substitute other examples of computing systems, processors, operating systems and tools for those mentioned above. As such, the teachings of this invention are not to be construed to be limited in any way to the specific architecture and components depicted in FIG. 1.

Referring further to the drawings, FIG. 2 is a block diagram of a point of recordation terminal apparatus. A point of recordation terminal apparatus 200 comprises an asset & event capture circuit 210 comprising a high resolution digital camera, a video encoding & compression circuit, and an image encoding & compression circuit; the asset & event capture circuit coupled to a reference selection & meta-tagger circuit 220 and the reference selection and meta-tagger circuit couples to a formatting circuit 222 and further coupled to an asset and reference archive store 240. When it has been determined that the asset capture circuit has detected an event of interest, an asset is initiated and processed as directed by the appropriate policy, normally storing into an archive. As the asset is being generated, a reference is composed by selecting a representative frame of the video to scale and compress, recording the beginning of the event of interest, and accumulating relevant metadata about the generated assets. A processor controlled by computer-readable instructions to perform steps of the present invention is one means for circuits disclosed in this disclosure. In an embodiment, a video encoding and compression circuit is a h.264 encoding circuit. In an embodiment an image encoding and compression circuit is a JPEG encoding circuit.

Referring to FIG. 3, at least one point of recordation terminal 200 is coupled to a network 501 through its network interface 230. In an embodiment, the network is a private network. In an embodiment, the network is a wireless cellular network. In an embodiment of the present invention, an apparatus comprises a point of recordation terminal 200 comprising a network interface 230, the network interface coupled to a network 500.

6

Referring to FIG. 4 The present invention is distinguished by executing policies stored in policy store 250 in a bandwidth controller circuit 232 to support and mutually benefit the methods of operating a wireless cellular network. Combined with identity information for the specific PORT, as directed by policy, the reference is transmitted through the network interface 230. Policies also control what is determined to be an event and control the formatting circuit and control the bandwidth assigned.

Referring to FIG. 5, in an embodiment of the invention, references and assets are encrypted. In an embodiment assets and references are encrypted using a key in encryptor circuit 283 before transmission through the network interface 230. In an embodiment, assets and references are encrypted within the point of recordation terminal 200 prior to archive store. By using encryption circuits, a public network 500 can be used to lower the cost of providing these services. By using strong encryption keys with the assets and references, the resulting artifacts can be safely stored in environments with potential security flaws such as cloud services.

The encryption attached to the assets and reference clearly distinguishes the present invention from conventional systems which use transport level security. Once files have completed transport in a conventional system they can be read by anyone representing a continuing loss of privacy for as long as they are stored. In contrast the encrypted assets and references are stored in encrypted format and may never be decrypted at all before expiration. Because encryption securely associates the asset with the device and time of creation, there is provenance for the assets and references. In an embodiment, each unit has a unique private key of a key pair. It is known that a digital signature can establish the source of an image is a specific camera. This can be distinguished from conventional transport level security which does not provide provenance back to the specific PORT and time of the event of interest, and creates a security vulnerability as assets are processed and typically stored in a decrypted format.

Referring to FIG. 6, a method of operating the present invention during outage comprises the steps of the connection manager 234 determining from signals of the network interface that the network is congested or defective, selecting a policy defined for handling assets and references, the policy to control:

- storing references from the reference selection & meta-tagger circuit 220 into the archive store 240,
- storing assets into the archive store 240 if there is available capacity,
- discarding stale assets in the archive store and storing new assets into the archive store,
- discarding new assets if it determines that there is no capacity,
- discarding new references if it determines that there is no capacity, and
- testing for restoration of network connectivity and improved bandwidth.

Referring to FIG. 6, the present invention comprises a method for operating an embodiment for recovery after network outage or congestion. In an embodiment, references are stored in the archive store 240 during network outage or congestion as controlled by the bandwidth controller 232. In a non-limiting example, network congestion or outage could cause low or no bandwidth while the PORT 200 is itself operating and detecting events. When the method determines that the outage is ended or that bandwidth constraints have loosened, a new policy is selected, which directs that

US 9,472,069 B2

7

references which have been queued in archive **240** be transmitted immediately with no bandwidth restrictions.

Referring to FIG. 7, in normal, unattended operation the operation of a specific PORT apparatus **200** is as follows: as an assets and event capture circuit processes a plurality of images frames and determines if an event of interest is in progress, a policy based bandwidth controller circuit **232** selects the normal policy which directs it to store assets in the archive store **240** and transmit references immediately over the network interface **230** to connected network **500** to the designated POA.

Referring to FIG. 8, while processing, the upload manager **260** monitors the status of other elements, in an embodiment including archive store **240** to determine if it is nearing capacity and network interface **230** to determine if it is functioning correctly, and selects alternate processing policies for process assets according to the determined state. Alternate policies for archive store nearing capacity include deleting old assets, deleting selected old assets types (video, high resolution snapshots), and not storing new assets. Alternate policies for network connectivity are outlined earlier.

If connectivity between a point of recordation terminal and the network is lost or degraded, but the PORT is otherwise functional, it selects a different policy to guide storage and of assets and references.

In an alternative operating mode, the bandwidth controller is configured with a policy so that the PORT transmits assets and references as they occur. By storing a copy of the transmitted data while the transmission is occurring, the PORT can provide recovery of data in the event a transmission is determined to be unsuccessful while the transmission is occurring. When the transmission failure is detected, the remaining portions of the assets and references are generated as normal but not transmitted. When network connectivity is restored, recovery can be accomplished as above.

In an embodiment, a POA **300** may request a live feed from a specified PORT **200**. A live feed is differentiated from the asset and reference model in that no event of interest is necessarily involved. Instead the PORT artificially forces an event of interest to be created independent of the content of the images. The artificial event of interest has a reference image, typically determined by taking the first image in the sequence. Similarly, the other aspects of the event of interest are created independent of the data. If an event of interest does occur during the sequence of images created by the live stream, it is handled as described in multiple events of interest below. The PORT apparatus responds to the request for live streaming by selecting an appropriate policy, which typically directs the bandwidth controller to allow unlimited transfer of live asset information to the network interface **230**, passing the processed video information (encoded, formatted, and encrypted) directly to the network interface as it is generated, and indicating to the reference generation circuit that an artificial event is in progress.

In an embodiment a PORT includes a connection management circuit **234** for interacting with the POA outside of the upload of assets and references. The connection manager establishes an outbound connection to the POA to allow the PORT to function without requiring any inbound connections. Amongst other things, the connection manager is used to download and modify policies for the bandwidth controller. The connection manager also allows the POA to request the immediate upload of a specific stored asset. The PORT responds to this request by immediately transmitting the requested asset under a specific policy, typically no bandwidth constraints.

8

It is understood that a network may be a private network, a local area network, a public network, or a combination of the above such as the internet. Further, the network may be a wireless local network, a wireless cellular network, or a wired network. The invention is specifically distinguished in its ability to function with relatively low bandwidth and unreliable connections, as typically required for wide area networks, either wired or not. Each point of recordation terminal **200** is also coupled to the network by a network interface **230**. It is further understood that a network in the present patent application is defined to include proxies, pass-throughs, and other elements which do not change interface modality.

A point of recordation terminal further comprises an asset & event capture circuit **210**, a reference selection and meta-tagger circuit **220**, and an archive store **240**, the asset & event capture circuit coupled to the reference selection & meta-tagger circuit, the network interface **230** coupled to the reference selection & meta tagger circuit and coupled to the archive store.

A PORT further comprises a connection management circuit **234** coupled to the network interface **230**. The connection management circuit establishes a connection to allow configuration and management of the PORT. Because the connection management circuit and the transmission circuit disclosed below both utilize a connection initiated from the PORT to the POA, they are compatible with typical network configurations such as NATs (network address translators, which fake a public IP address for a local network device with a private IP address) and Firewalls (which typically restrict almost all inbound traffic but little if any outbound transactions). In an embodiment, the connection is an HTTP request initiated by the PORT which is periodically timed out and re-initiated. If the POA has a configuration directive for the specific PORT in question, it responds to the HTTP request with the contents of the directive. Subsequent requests from the PORT provide the status and results of the configuration directive. Upon reception of the configuration directive, the PORT executes the command and re-initiates the connection. In an embodiment, the PORT executes directives with an extend duration by creating a separate process or thread to process the command, while re-establishing and maintaining the connection to the POA, and including in the connection the status of the commands currently executing. In an embodiment, when a directive finishes, the HTTP connection is immediately terminated and re-established with the final status of the directive, providing immediate feedback of directive completion.

An embodiment of the invention is a method comprising the processes of: determining if motion has occurred, defined as an event of interest, defining a small single image to represent the event of interest in a time correlated manner, locally imaging data at all times at all cameras, determining if locally analyzed images are not needed, not recording or transmitting except for minimal statistics information.

An embodiment of the invention is a process for recognizing an event of interest and storing an asset and at least one reference to associate as exemplary of the event. The process comprises known methods for motion detection, known methods for object detection, and known methods for object recognition and the following steps: triggering on matching an event of interest pattern within a certain sequence of images, selecting an exemplary image from the sequence, scaling the exemplary image, compressing the exemplary image, recording the start and end times of the event of interest, and additional metadata sufficient to effi-

US 9,472,069 B2

9

ciently process and uniquely address the associated asset on the PORT. In an embodiment, an exemplary image is selected from the sequence of images in motion as the image with the largest pixel difference from a reference image in the sequence. In an embodiment of the method, the method further comprises operating on the event of interest to generate a high resolution image asset. In an embodiment of the method, the method further comprises operating on the event of interest to create a very compact image representative. By operating on the event of interest is included the non-limiting examples of no scaling and compression, scaling and compressing in a highly lossy manner, and JPEG encoding. In an embodiment, the method further comprises the step of recording additional metadata derived from the event of interest, by computing the amount of motion detected on each frame and an indication of the current logical mode of the motion detection circuit, including preroll, motion, and postroll. In an embodiment the method further comprises creating reference information for an asset to facilitate the processing or retrieval of assets, in an embodiment the asset size in bytes.

It can be appreciated that the operation on an event of interest described is in anticipation of the POA providing primarily a direct user interface to allow humans to rapidly select events of interest for further analysis. In anticipated implementations of a PORT alternative reference and asset information will be captured to allow efficient computation processing of references to determine if an event of interest requires further analysis, and subsequent processing of the associated assets. Specifically, is known that object recognition algorithms can identify the type of object (such as car, person, face) being imaged and its location. Further it is known additional artifacts can be produced from such object recognition processing, such as the specific features and their spatial relationship. In support of a POA doing object processing, a reference would contain limited categorization information and the reference would contain the detailed object features. Thus the PORT architecture of references and assets should not be constrained to the specific type of references and assets disclosed.

In an embodiment of the invention, the PORT further comprises an asset upload manager circuit. The upload manager circuit functions under a selected policy to send assets to the POA without request from the POA. In anticipation of the POA needing a significant percentage of the assets, and in acknowledgement that a PORT must have limited archive capacity, the upload manager attempts to send assets proactively to the bandwidth controller 232 for transmission. The bandwidth controller selects a policy appropriate for the background upload of assets (typically a significantly limited bandwidth allocation) and sends the assets at or below the defined rate. The upload manager also tracks the status of reference and assets in the archive, and under policy control can immediately delete references and assets once they have been transmitted, delete them when the archives near capacity, or not delete selected or all assets. In practice, the events of interest occur infrequently and have limited duration, the background transmission of assets can be accomplished in a small fraction of the bandwidth required for transmitting the data in real-time. The upload manager policy can be selected based on conditions including the current status of the archive store, and the time of day and day of the week. Policies for the upload manager include sending all assets in order of storage, sending assets in reverse order of storage, and sending selected types of assets first, followed by different type of assets. In an embodiment, an upload manager circuit comprises a processor coupled to

10

a policy store, the policy store comprising computer readable media encoded with instructions to adapt the processor to perform the above disclosed steps and processes. The policy store is further coupled to the connection manager whereby the contents of the policy store can be initially configured and updated.

The present invention comprises a computer implemented method for archive transmittal containing the steps of storing assets locally to the PORT, tracing assets through a common ID in reference data to allow an arbitrary delay between capture and upload of the asset, limited only by the storage available in the PORT. As the bandwidth controller determines that bandwidth is underutilized, assets are transmitted using the established reference information to allow a POA to associate the assets uploaded in the this background manner with the originating reference data. A policy guides but does not dictate the operation of the bandwidth controller. In an embodiment, a policy assigns bandwidth by time of day and day of week. In an embodiment, the policy assigns bandwidth during network failures by defining the amount of time to wait in response to a network failure before attempting transmission of a stored asset. In an embodiment, the bandwidth controller may autonomously adapt the policy to use more bandwidth if the asset store is becoming full.

In an embodiment of an apparatus for documenting at least one occurrence of an event of interest the apparatus comprises a digital camera coupled to a network interface, the camera, and the network interface coupled to the following:

a means for determining when an event of interest occurs, in an embodiment a circuit comprising a processor controlled by software to execute the following computer-implemented steps: motion threshold, and

a means for selecting an extent of data associated with the event of interest to accurately represent the event, in an embodiment a circuit comprising a processor controlled by software to execute the following computer-implemented steps: marking motion activity plus a preroll and postroll, motion object tracking with analysis artifacts;

a means for efficiently recording the selected extent of data in an embodiment a circuit comprising a processor controlled by software to execute at least one of the following computer-implemented steps: to h264 encode, to JPEG encode;

a means for storing the recorded events in an embodiment a circuit comprising a processor controlled by software to execute the following computer-implemented steps: to write to flash memory, to write to SD-card, SDXC-card, SDHC-card or equivalent non-volatile memory card, to write to disk; and

a means for deriving more compact representations of the event which can assist in determining if the event is of further interest, in an embodiment a circuit comprising a processor controlled by software to execute the following computer-implemented steps: to generate highly compressed images, timestamps, motion metadata, and descriptive information for each asset.

In an embodiment, a means for determining when an event of interest occurs in an embodiment a circuit comprises a processor controlled by software to execute the following computer-implemented steps: to determine if multiple events of interest occur in close proximity, to cause a single extent of data to be recorded indicative of multiple event representations, each of which provide indication of where in the extent the event occurred. In an embodiment, if during an event of interest or during the postroll period

US 9,472,069 B2

11

after an event of interest, a new event of interest is determined to occur, a new set of reference data and image asset data is generated, and the sequence of images captured is continued to included the subsequent event of interest. The reference data and assets have an offset associated with them to indicate at which number in the sequence of images represented by the compressed video they occur.

In an embodiment, a means for storing recorded events and a means for deriving compact representations comprises a circuit comprising a processor controlled by software to execute the following computer-implemented steps: to encrypt data for later decryption

In an embodiment a means for storing the recorded events comprises in an embodiment a circuit comprising a processor controlled by software to execute the following computer-implemented steps: to store them locally on the device and to transmit according to a policy implemented in a bandwidth controller circuit.

In an embodiment an apparatus for transmitting compact representations of an event of interest over an unreliable network comprises,

a means for connection comprising at least one of a private network, an IP network, a cellular network, or an IP network over cellular network;

the means for connection coupled to a first network interface circuit and to a second network interface circuit, the first network interface circuit coupled to a means for transmission of compact representations,

wherein the means for transmission of compact representations comprises in an embodiment a circuit comprising a processor controlled by software to execute the following computer-implemented steps: to determine if the representation cannot be immediately transmitted, to store the representations locally and to retry transmission at a later time; and a means for reception coupled to the second network interface,

A PORT comprises a transmission circuit which transmits data to a POA. In an embodiment, the PORT transmission circuit is a processor adapted by a software implementation of the HTTP protocol, which initiates a separate transaction for uploading each set of references and assets associated with a event of interest. In an embodiment for streaming, the PORT transmission circuit is adapted to perform the method of the HTTP chunked data transmission model which incrementally transfers large media assets as they are generated. In an embodiment, the PORT transmission circuit maintains a record of data transmitted but not acknowledged by the protocol, and in the event the HTTP transaction fails to complete correctly, the information can be stored in the local archive for later recovery.

In an embodiment, a PORT further comprises a formatting circuit which processes the compressed video to a format that allows streaming without reformatting as well as storage (RTP based protocols allow streaming, MPEG 4 allow storage but not both). In an embodiment the video is formatted in the flash FLV format for H.264 video. In an embodiment, a formatting circuit of the PORT couples to the archive store and to a bandwidth controller and to a policy store to interpret a standard H.264 bit stream or reference format and convert the data stream directly into the FLV format while adding minimal (less than a frame) of latency.

In an embodiment, a PORT further comprises a video encoder circuit which runs constantly, to generate a valid H.264 video stream. In an embodiment, a PORT further comprises a formatting circuit coupled to a video encoder circuit to detect reference or key frames (I Frames in H.264 nomenclature) and always starts video sequences at I Frame

12

boundaries. In an embodiment, a PORT further comprises a transmission circuit which stores a sequence of compressed video frames starting with an I Frame as a preroll buffer, enabling preroll buffering in the compressed space, significantly reducing the storage required for preroll.

In an embodiment a point of recordation terminal comprises a circuit comprising a processor controlled by software to execute at least one of the following computer-implemented steps:

to change configuration of other circuits in the terminal, to transmit immediately when directed by means for analysis,

to store events if immediate transmission fails, and to specify all data should be recorded and transmitted immediately for a limited period.

In an embodiment the invention comprises a method for operating an apparatus to reliably represent high complexity continuous data over a low bandwidth and unreliable connection, the apparatus comprising:

a point of recordation terminal (PORT) coupled to a connection,

the connection comprising at least one of an IP network, a cellular network, and an IP over cellular network, the method comprises capturing, and transmitting an event of interest, wherein capturing an event of interest comprises the following processes:

determining when an event of interest occurs, selecting an extent of data associated with the event of interest,

efficiently recording the selected extent of data, deriving a compact representation of the event of interest, and

storing the recorded events; wherein transmitting an event of interest comprises the following processes:

transmitting immediately when directed and storing if immediate transmission fails, opening a client session to a server at a designated address

transmitting data over the session, maintaining a record of data transmitted but not acknowledged,

recording the record of data in the event the transmission session fails

storing recorded events locally and transmitting when an acceptable amount of bandwidth becomes available, and responding to subsequent request to immediately transmit a stored record by transmitting the data rapidly.

In an embodiment a point of recordation terminal apparatus comprises:

a high resolution digital camera,

a first storage device,

a first network interface,

a circuit controlled by software to signal a motion threshold,

a circuit controlled by software to measure motion activity,

a circuit controlled by software to track motion objects with analysis artifacts,

a circuit controlled by software to encode h.264 format files,

a circuit controlled by software to encode JPEG files,

a circuit to write to flash memories (as non-limiting example an SD card),

a circuit to generate small reference images, timestamps, motion and asset meta-data,

a circuit controlled by software to determine if multiple events of interest occur in close proximity,

US 9,472,069 B2

13

a circuit controlled by software to cause a single extent of data to be recorded indicative of multiple event representations and where they occur,

a circuit controlled by software to store assets locally on the first storage device and to retry transmission at a later time wherein

a circuit comprises a processor controlled by software instructions and the processor is coupled to the first network interface, the processor is coupled to the first storage device, and the processor is coupled to the high resolution digital camera.

In an embodiment of the invention, a PORT further comprises a policy store, the policy store coupled to the connection manager, a formatting circuit, the formatting circuit coupled to the policy store, to the archive store, to the upload manager, and to the bandwidth controller and to the video encoding circuit. In an embodiment of the invention, a PORT further comprises an upload manager circuit coupled to the archive store and to the policy store, and to the bandwidth controller. In an embodiment of the invention, a PORT further comprises a connection manager coupled to a policy store and coupled to the network interface.

In embodiments of the invention, a PORT further comprises at least one of a policy store, a connection manager, a formatting circuit, and an upload manager. The policy store is coupled to the connection manager, the formatting circuit, the upload manager, the bandwidth controller, and the asset and event capture circuit. The formatting circuit is further coupled to the video encoding circuit, to the archive store, to the bandwidth controller. The upload manager circuit is further coupled to the archive store, and to the bandwidth controller. The connection manager is further coupled to the bandwidth controller and to the network interface. Therefore, policies which determine actions upon certain conditions are received from the network by the connection manager and stored to the policy store whereby the upload manager circuit determines which and how quickly assets are transmitted via the bandwidth controller and the network interface, whereby the formatting circuit determines how to convert raw video to streamable video and how to determine the preroll and post roll parameters, whereby the connection manager changes the operating mode upon certain conditions specified in a policy stored in the policy store.

In an embodiment, a PORT provides metadata captured outside of events of interest which represents the basic inputs to the event of interest determining circuit. In an embodiment a PORT periodically uploads this information as it is generated. The upload of this information allows a POA to analyze the PORT configuration to determine if some other configuration would better capture appropriate events of interest. The periodic upload allows the POA to determine the basic operational status of a connected PORT.

A bandwidth controller circuit executes a first bandwidth management policy for the upload of references and a second bandwidth management policy for the upload of assets. Different modes distinguish “real time” and the recovery mode. The bandwidth controller circuit implements retention policies for both on camera assets, and on camera references. In an embodiment, if a camera runs out of space, the bandwidth controller circuit determines what to throw away (in an embodiment it throws away complete asset sets for oldest events), but it can do other things—throwing away “snapshots” but keeping the video for example.

In an embodiment a bandwidth controller is set to one of several policies in the event of losing network connectivity, such as the non-limiting exemplary policies: storing for

14

recovery and just discarding. A service provider offers additional capacity at incremental pricing. In an embodiment the PORT self regulates its uploading of an asset according to its embedded policy. In an embodiment a server removes bandwidth limitation for a specific asset (and no other transfer) and demands that asset be uploaded without delay. Accordingly, the PORT records such a demand upload and removes it from the queue of assets remaining.

In an embodiment, a PORT receives a policy conditioned on whether a camera has storage available and on whether services have been selected for subscription. Specifically an SD card slot in the camera enables bandwidth shaping. In an embodiment data on the SD card is independently available without decryption. In an embodiment data on the card is stored encrypted.

In an embodiment, the bandwidth controller is a processor controlled by software for policy management for to determine when to upload and how much. In an embodiment it utilizes time-of-day (e.g. don’t contend for internet connection when customers are using wi-fi service, but change bandwidth limits after midnight). In an embodiment it utilizes reliability measurements (if packet loss on the link exceeds a threshold, back off sending for a random or fixed time amount to reduce contention). In an embodiment the bandwidth controller circuit utilizes pricing models to determine when to upload and how much (e.g. if unlimited connectivity on my wireless plan after 7, only send references then). In an embodiment, a set of PORTs are organized as a group and bandwidth policy is managed among the group.

An apparatus for generating and storing an asset comprises a digital camera coupled to video memory, the memory coupled to an archive store such as a removable SD flash memory card, and a processor coupled to all the above and to a network interface card.

One means for reading and encoding a camera identification is a processor encoded with a PrettyGoodPrivacy strong encryption algorithm and a private key. One means for reading and encoding a time of day of the asset is reading Unix time from an internet server at the time the first video frame is captured by a digital camera attached to a processor. One means for selecting and storing at least one high resolution digital photograph is a motion detection circuit coupled to a memory configured as a pipeline coupled to a digital camera. Another means is comparing each digital camera frame to a reference frame and capturing a frame having a number of pixels above a threshold different from the reference frame. One means for deriving and storing a medium resolution video image sequence is a jpeg or mpeg chip coupled to a video memory and writing to a flash memory. One means for reading and encoding at least one offset of at least one high resolution digital photograph relative to the time of day of the asset is subtracting the time of the start of the asset from the time at the threshold crossing frame.

The apparatus comprises a circuit coupled to a video memory and writing an asset to a flash memory wherein the asset is an encrypted digital file.

One means for determining and encoding a type of event is reading from the threshold circuit comparing a reference frame to a video frame the parameters of difference. One means for computing and storing a digital signature is encoding a processor with a PrettyGoodPrivacy algorithm and combining a private key, the time of day of the asset, and the size of the asset or reference. One means for determining and storing a preroll before the start of the event is counting the stages of a pipeline memory from the entrance until the

US 9,472,069 B2

15

point that an event has been determined. One means for determining and storing a postroll after the end of the event is adding a fixed value to the time of the end of the event.

The apparatus comprises a processor adapted to read a video memory and generate a reference which is an encrypted digital file.

One means for deriving a low resolution, scaled still image is encoding a processor with a JPEG algorithm, reducing the scale of a photograph to less than 100.times.100 pixels, and setting the JPEG algorithm to low resolution. One means for reading and storing a size of the asset is instructing a processor to read the file header from the flash memory controller.

One means for deriving meta-data values includes a processor reading output values from a circuit for graphics processing coupled to a video memory.

Said means comprises a circuit comprising a processor coupled to computer-readable media encoded with instructions for computing meta-data values, determining the size of an asset, determining an event, selecting a high resolution digital photograph from an image sequence, converting an image sequence into a medium resolution video image sequence, deriving a compressed, scaled, low resolution representation from a selected high resolution digital photograph, reading camera identification and computing a digital signature, wherein a reference comprises a plurality of digital files encoded by strong encryption.

Means for reading and encoding a PORT identification include a processor encoded to perform a digital signature on an encoded image using a private key unique to the PORT.

Means for generating a PORT unique identification for the asset include a processor encoded to
 increment an event number, or
 encode the time and date of the event.

Means for generating multiple representations of the event include a processor encoded to:

include an encoded video representation of an image sequence representative of the event,
 wherein an image sequence representative of an event includes images from immediately before the event of interest,

wherein an image sequence includes image from immediately after the event of interest;

to indicate the relative activity detected in each image of the sequence;

to include data derived from analysis of the event of interest;

to include an encoded high resolution image of an image representative of the event;

to reference two grouping of representations, one optimized for minimizing the number of bytes required and one optimized to accurately represent the event of interest;

to identify two groups associated by the unique identifier, wherein one of the two groups provides indication of the exact representations in the available in accurate representation, wherein one of the two groups includes size, relationship, and type indication; and

to combine representations into a single larger group if two events of interest occur sufficiently close in time that events immediately before or after would overlap.

Means for indicating the timing relationship between different representations include a processor encoded to:

record the sequence number of the image from the start of the representation, or

record the time and data of the representation.

16

An apparatus is disclosed comprising a digital camera coupled to a formatting circuit coupled to an encryption circuit coupled to an archive store, wherein the encryption circuit comprises an input for reading a unique camera identification key, an input for reading a video stream from the formatting circuit, a processor for encoding the video stream with time, date, and the unique camera identification key, and an output for writing the resultant encoded video stream to the archive store.

An apparatus is disclosed comprising a digital camera coupled to a reference select & meta-tagger circuit coupled to a formatting circuit coupled to a connection manager circuit coupled to a network interface, wherein the connection manager circuit comprises a processor controlled by software to perform the following operations: reading a destination IP address hardcoded onto the connection manager circuit board, receiving a compact representation of an event of interest from the reference select & meta-tagger circuit, preparing packets with the destination IP address containing the compact representation, opening a client session with the destination IP address, and transmitting the packet as a client to a server at the destination IP address.

A point of recordation terminal apparatus is disclosed comprising:

a network interface, the network interface coupled to a network;

an asset & event capture circuit;

a reference selection & meta-tagger circuit;

a bandwidth controller circuit; and

an encryption circuit, whereby captured assets and references are encrypted prior to transmission.

The apparatus further comprises an archive store coupled to the encryption circuit whereby captured assets and references are stored in encrypted form into the archive store.

The encryption circuit is uniquely associated with the specific PORT by cryptographic operation. The encryption circuit indicates the time and date of the event of interest by cryptographic operation on the assets.

A method is disclosed comprising transmitting a reference immediately while storing an asset into the archive store. The method further comprises temporarily storing the transmitted reference and storing it to the archive store in case the transmission fails.

By storing is meant the steps of detecting when the transmission is likely to be possible again and retransmitting the reference.

A point of recordation terminal apparatus is disclosed comprising:

a network interface, the network interface coupled to a network;

an asset & event capture circuit;

a reference selection & meta-tagger circuit;

wherein the network interface comprises a configuration detection circuit whereby it automatically detects and configures its network interface settings.

A method of operating the configuration detection circuit is disclosed comprising sequentially trying the following processes until a working configuration is established: DHCP, static configuration and auto-detection, wherein auto-detection comprises

determining the local addressing scheme;

selecting a host address not detected in the local network, probing the selected address to determine if used, and reselecting if collision is detected; and

US 9,472,069 B2

17

sending a prospective transaction on at least one port to each identified hosts on the local network to determine if any act as a gateway, and selecting a host as a gateway if successful.

In an embodiment, determining the local addressing scheme comprises passively listening to network traffic to determine the local addressing scheme and hosts on the networks. In an embodiment, determining the local addressing scheme comprises actively probing the network to determine the local addressing and hosts on the local network.

A point of recordation terminal apparatus is disclosed comprising

a network interface, the network interface coupled to a network;

an asset & event capture circuit;

a reference selection & meta-tagger circuit; and

a connection manager circuit, whereby the connection manager and the network interface establish client sessions to a server at a known location.

Methods of operating the apparatus include without limitation the following independent processes:

establishing an HTTP or HTTPS protocol client session.

receiving commands issued by a server responding to a client.

periodically reestablishing its client connection to a server.

processing a command to quickly reestablish a client connection.

providing status indication for commands currently running in a client connection and for commands recently completed in a client connection; and other methods for operating the apparatus known in the art.

Conclusion

The present invention is distinguished from conventional video surveillance systems by using a public network enabled by its bandwidth controller and encryption circuits, by providing for low bandwidth reference transmission in near real time while queuing multi-frame assets for policy controlled transmission, and policy controlled bandwidth control in response to recovery, normal operation, streaming, and searching.

The present invention is distinguished from conventional cameras by determining if motion has occurred within a period, creating at least one reference indicative of the motion, transmitting the references in real time, and only storing, analyzing, or uploading data around times of motion to reduce bandwidth consumption. In particular, the invention allows efficient and secure use of cloud computing. By encrypting assets and references on a per PORT and per user basis and not decrypting them during upload and storage, the security and providence of the data is assured even when using resources shared across many different companies. The PORT is distinguished from convention video cameras by using only outbound network connections compatible with a wide area network to establish connection with a POA. It is particularly pointed out and distinctly claimed that a network can connect using a cellular network as the back haul as the disclosed bandwidth utilization model makes it practical and affordable (since cellular bandwidth is very expensive compared to landline/wi-fi).

Significantly, this invention can be embodied in other specific forms without departing from the spirit or essential attributes thereof, and accordingly, reference should be had to the following claims, rather than to the foregoing specification, as indicating the scope of the invention.

18

The invention claimed is:

1. A method for generating and storing an asset from a Point of Recordation Terminal (PORT), comprising: collecting a unique identification of the PORT; determining an event of interest by the PORT; generating multiple representations of the event of interest determined by the PORT, wherein the multiple representations include both video and still images of the event derived from the video;

identifying timing relationship between the multiple representations of the event of interest determined by the PORT;

associating the unique identification of the PORT with the multiple representations of the event of interest determined by the PORT;

encrypting and uploading the multiple representations of the event of interest with the unique identification of the PORT for cloud storage.

2. The method of claim 1 wherein the asset is an encrypted digital file.

3. The method of claim 1 further comprising: determining and encoding a type of event.

4. The method of claim 1 further comprising: computing and storing a digital signature.

5. The method of claim 1 further comprising: determining and storing a preroll before the start of the event.

6. The method of claim 1 further comprising: determining and storing a postroll after the end of the event.

7. The method of claim 1 further comprising: deriving a metadata value for the number of moving objects.

8. A method for generating and transmitting a reference of an event of interest, comprising:

determining the event of interest by a Point of Recordation Terminal (PORT);

composing a reference by selecting a representative frame of a video of the event of interest generated by the PORT;

reading and encoding a time of day of the event of interest by the PORT;

storing a type of the reference;

identifying and encoding an offset of the reference relative to the time of day of the event;

encrypting and transmitting the reference with the offset and the time of day of the event.

9. The method of claim 8 wherein a reference is an encrypted digital file.

10. The method of claim 8 further comprising: determining and storing a digital signature.

11. The method of claim 8 further comprising: deriving a low resolution, scaled still image representative of the event of interest.

12. The method of claim 8 further comprising: reading and storing a size of the multiple representations of the event of interest.

13. The method of claim 8 further comprising:

deriving a meta-data value for speed of moving object.

14. The method of claim 8 further comprising: selecting a high resolution digital photograph from an image sequence of the event of interest, converting the image sequence into a medium resolution video image sequence,

deriving a compressed, scaled, low resolution representation from the selected high resolution digital photograph.

US 9,472,069 B2

19

15. A point of recordation terminal (PORT) comprising:
 an asset & event capture circuit configured to:
 determine the event of interest by a Point of Recordation Terminal (PORT);
 generate a video stream of the event of interest generated by the PORT;
 an encryption circuit,
 wherein the encryption circuit comprises:
 an input for reading a unique camera identification key,
 an input for reading a video stream from the formatting circuit,
 a processor for encoding the video stream with time, date, and the unique camera identification key, and
 an output for writing the resultant encoded video stream to the archive store.

16. A point of recordation terminal (PORT) comprising:
 an asset & event capture circuit configured to:
 determining an event of interest by the PORT;
 capturing multiple representations of the event of interest determined by the PORT, wherein the multiple representations include both video and still images of the event derived from the video;
 identifying timing relationship between the multiple representations of the event of interest determined by the PORT;

20

associating a unique identification of the PORT with the multiple representations of the event of interest determined by the PORT;
 an encryption circuit configured to encrypt the captured representations of the event of interest prior to transmission; a network interface configured to upload the multiple representations of the event of interest with the unique identification of the PORT for cloud storage.

17. The apparatus of claim 16 further comprising:
 an archive store coupled to the encryption circuit whereby captured assets and references are stored in encrypted form into the archive store.

18. The apparatus of claim 16 wherein the encryption circuit is uniquely associated with the specific PORT by cryptographic operation.

19. The apparatus of claim 18 wherein the encryption circuit indicates the time and date of the event of interest by cryptographic operation on the assets.

20. The apparatus of claim 17 wherein the network interface is configured to:
 transmit a reference immediately while storing an asset into the archive store;
 temporarily store the transmitted reference and storing it to the archive store in case the transmission fails, detect when the transmission is restored, and retransmit the reference.

* * * * *

Exhibit C

to

Complaint

for Patent Infringement

Claim Chart¹ for the '888


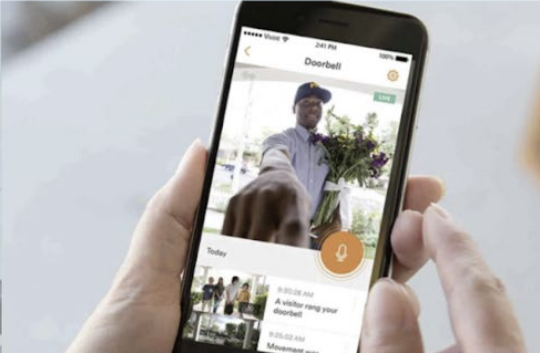
Patent

¹ Plaintiff provides this exemplary claim chart for the purposes of showing one basis of infringement of one of the Patents-in-suit by Defendant's Accused Products as defined in the Complaint. This exemplary claim chart addresses the Accused Products broadly based on the fact that the Accused Products infringe in the same general way. Plaintiff reserves its right to amend and fully provide its infringement arguments and evidence thereof until its Preliminary and Final Infringement Contentions are later produced according to the court's scheduling order in this case.




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CLAIM CHART

U.S. PATENT NO. US 8,558,888 B2– CLAIM 1

Claim 1	Corresponding Structure in Accused Systems – Vivint
<p>[1a] A method for operating an apparatus for to reliably maintain high complexity continuous data over a low bandwidth and unreliable connection, the apparatus comprising:</p>	<p>Vivint sells various smart security devices. Their products include security cameras—both wired and wireless. <i>See</i> https://www.vivint.com/.</p> <p>Vivint’s products include indoor/outdoor cameras as well as sensors and alarms. All wireless products are wifi-enabled. These products (“Accused Products” or Vivint’s “Cameras”) form a point of recordation terminal and operate to generate and store an asset from the Accused Products. Vivint devices are configured to upload and store photo and video assets to be downloaded and watched later via the Vivint cloud.</p> <p>For example, Vivint devices, together with Vivint services, can generate and store an asset captured from a Vivint device. <i>See below.</i></p> <div data-bbox="689 691 1753 1364">  <p>Storage for up to 30 days</p> <p>With Vivint smart drive, you can store up to 30 days of footage. You can play footage of any date and time that occurred during this period.</p> <p>Access to Footage</p> <p>As Vivint cameras have wireless connectivity to the smart drive, you can access the footage at the instant. With your Vivint smartphone app or Smart Hub, you can play back any footage and check recordings whenever or wherever you want. The simple way of footage access makes it easier for you to go through data of long durations since you don't need to have any specific setup for viewing.</p>  </div> <p>Source: https://vivint.security/vivint-smart-drive/</p>

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<p>[1b] a point of recordation terminal (PORT) coupled to a connection,</p>	<p>Vivint cameras can record video and send data to the cloud. Additionally, the Vivint Camera’s default setting uses wifi as a connection in order to send data to the cloud. <i>See below.</i></p> <div><div><p><u>Doorbell Camera Pro</u></p><p>The Doorbell Camera Pro not only notifies you when packages arrive, it is the only video doorbell camera that proactively protects them.</p><p>Learn more →</p><p>Overall Rating</p><p>★★★★★</p><p>WIFI</p><p>✓</p><p>Night Vision</p><p>✓</p></div><div><p><u>Indoor Camera</u></p><p>Captures footage when motion is triggered, and you can also see and talk with family members or pets right through the camera.</p><p>Learn more →</p><p>★★★★★</p><p>✓</p><p>✓</p></div><div><p><u>Outdoor Camera Pro</u></p><p>Thief walks up. Outdoor cameras with Smart Deter detect thief. Cameras scare thief away. Your home is protected and peace prevails.</p><p>Learn more →</p><p>★★★★★</p><p>✓</p><p>✓</p></div></div> <p>Source: https://www.vivint.com/packages/security-cameras</p>
<p>[1c] the method comprising capturing, and transmitting, an event of interest, wherein capturing an event of interest comprises the following processes:</p>	<p>Vivint cameras can capture and transmit events of interest through the internet to a cloud service provider.</p>

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As a leading smart home technology provider, Vivint is proud to offer the newest and most innovative cloud storage solutions on the market. With their dedication to redefining the home experience through the use of intelligent products and services, Vivint “delivers services through a cloud-based platform that integrates a wide range of wireless features and components to provide simple, affordable home security, energy management, and home automation.”

In yet another bold and innovative move, Vivint acquired a cloud storage start-up company called Space Monkey, whose humble beginnings as a Kickstarter campaign gave birth to a unique consumer-focused cloud storage solution.

hardware. This means that the initial investment is slightly higher, however, the service is much cheaper than its competitors in the long run. While most cloud storage solutions cost about \$100 per year for 1 terabyte of storage, Space Monkey costs \$200 to start (for the hard drive) and \$50 per year thereafter for the same terabyte of storage.

The result? A cloud storage solution that offers both remote network backup and local storage for the highest level of functionality, data security, and redundancy. Vivint’s cloud storage services are fast, secure, on everyone’s devices, automatically backed up, easy to share, and accessible from anywhere.

Source: <https://www.vivint.com/resources/article/the-innovation-behind-vivint-cloud-storage-solutions>

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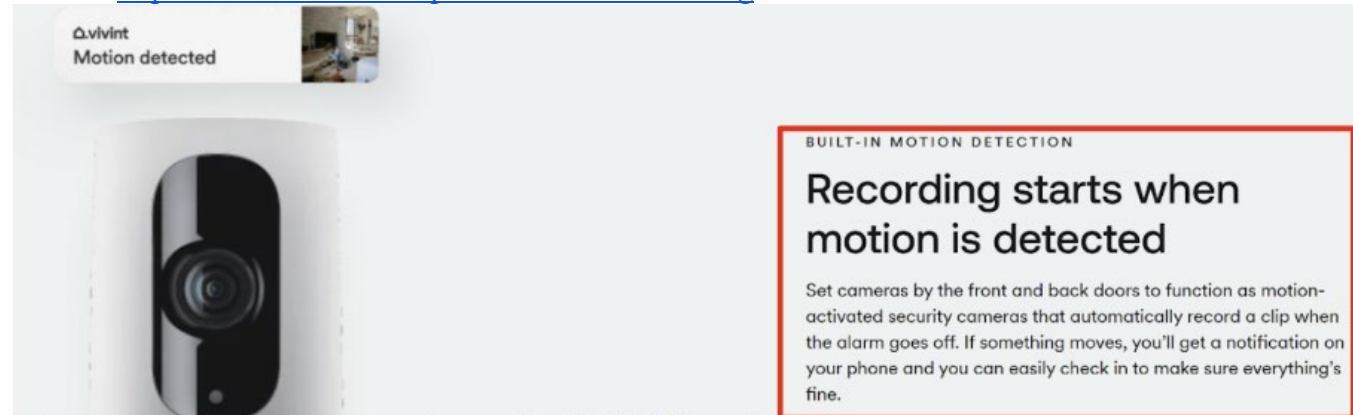
[1d] determining when an event of interest occurs;

Vivint cameras include built-in motion detection which is initially used to determine an event of interest. Vivint services offer different methods to determine an event of interest to reduce the number of unimportant events. For example, when an indoor camera senses movement or an outdoor camera senses someone lingering, an event is triggered. These events are illustrated below. Furthermore, Vivint offers other points of recordation terminal devices that do not include visual representation of the events of interest. *See below.*

Do you have to have a DVR for security Do security cameras record all the time??

Vivint security cameras automatically record when they sense motion. Smart Detection also ensures your cameras focus on people rather than pets or passing cars.

Source: <https://www.vivint.com/products/video-recording>



What recording rules can you set up with the Vivint Indoor Camera?

One of the unique features of the Vivint Indoor Camera is the ability to set custom recording rules so you're catching the action you want to see.

Vivint provides step by step instructions on how to create custom, system-triggered recordings for your Indoor Camera. A system-triggered recording means your cameras start recording when an event is triggered by a part of the system, like the door or door locks. Recorded video is a key component of a smart home, allowing you to monitor your living space, no matter where you are and watch recorded video at your convenience.

Learn more about how security cameras help make a smart home.

Source: <https://www.vivint.com/products/ping>

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SMART DETER

Detect, deter, protect

With its computer vision chip, the Outdoor Camera Pro offers enhanced Smart Deter to keep an eye on the area you define. If someone is detected and lingers too long, the Outdoor Camera Pro plays a loud sound and illuminates its LED ring, letting the lurker know they've been spotted. Your home is always protected with an outdoor camera that takes action automatically.

How does the outdoor camera record?

The in-camera analytics of the Outdoor Camera Pro trigger automatic video recording when a person is detected within the camera's field of vision. You'll only get notified when the camera identifies people, not pets or passing cars. And the camera doesn't stop recording until the action's over.

Browsing footage later is a breeze since recorded segments are automatically saved as Vivint Smart Clips. Watch clips at your convenience, or create custom alerts to notify you about activity around your home through your hub or app.

Learn more about how the award-winning [Outdoor Camera Pro](#) keeps home safe.

Source: <https://www.vivint.com/products/outdoor-camera>

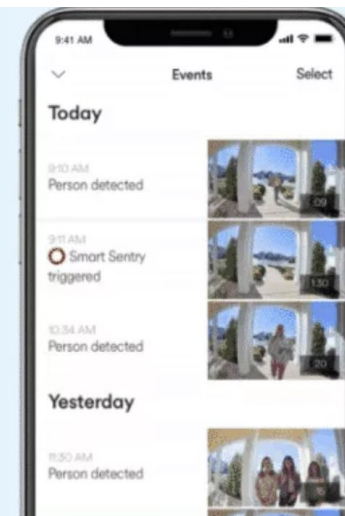
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[1e] selecting an extent of data associated with the event of interest;

Vivint's cameras can record 24/7. When an alert is detected, the camera records and saves a clip of the event. *See below.*

Event Markers

Event markers make your scrolling life easier. Whenever any motion is detected by Vivint cameras or other sensors, 20-second or 30-second clips are created, called smart clips. They are available on your timeline for a quick and easy search.



Source: <https://vivint.security/vivint-smart-drive/>

Do you have to have a DVR for security cameras?

Your security cameras themselves will store a certain amount of footage. Vivint cameras record 20- to 90-second clips, depending on the camera, for up to 14 days.

A DVR like Vivint Smart Drive—a 1T, low-cost video storage solution—can help you get the most out of your security camera video with a number of helpful benefits, including:

- Continuous recording that saves footage from up to four different cameras.
- Event markers that show motion-triggered activity for quicker searches.
- The ability to keep a record of every minute for 30 days.
- Smart Clips make it easy to download and share videos with friends, family, or authorities.

See why else it makes sense to have a [DVR for your security cameras](#).

Source: <https://www.vivint.com/products/video-recording>

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[1f] efficiently recording the selected extent of data;

Vivint cameras can record with a 140 degree field of view at high quality, 1080p, resolution for efficient viewing of camera recordings and live feeds. Additionally, cameras have night vision so that they can record effectively at night. *See below.*

SMART HOME SECURITY OUTDOOR CAMERAS

See it all, night or day

A 4K HD sensor delivers up to 1080p live streaming and recording, while a 140° field of view allows the Outdoor Camera Pro to capture more of your yard in more detail. High-powered IR night vision sensors let you see clearly both day and night—even when you zoom in on faces, license plates, and other details, the video maintains HD quality.

How to buy →

Specs

IMAGE SENSOR	4k Ultra HD with high dynamic range	MAXIMUM VIDEO RESOLUTION	1080p
FIELD OF VIEW	140°	CONNECTIVITY	PoE, PLC & Wi-Fi bridge
ZOOM	3x HD Zoom, 10x Digital	NIGHT VISION RANGE	55'

Source: <https://www.vivint.com/products/outdoor-camera>

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[1g] deriving a compact representation of the event of interest; and

Vivint's cameras use H.264 to compress the video to reduce file size from the raw image. For example, see the Vivint Outdoor HDP450 Camera Video Codec below.



Each Ip camera has a processing chip that compresses the video as it is recorded. What does the statement imply? Okay, the higher the resolution the camera displays, the more data each recorded video will store. Images resulting from high resolution demand more bandwidth and space to accommodate the transmission of data than images of low quality. The transmission of HD (High Definition) images over a network requires the IP camera to compress the files. Another alternative is for the camera to make the files smaller to evade the consumption of too much bandwidth. The current compression standards, for instance, MPEG-4 and h.264, demonstrate that there is either a small drop or no drop in the frame rate and resolution when the video footage finally reaches your computer or phone. This is also one of the advantages of IP cameras, for their videos can be viewed anywhere via tablets,

Source: <https://support.Vivintsecurity.com/hc/en-us/articles/4415263473043-What-is-Vivint-Text-Alert-Details-&Specifications>

Warranty	• 1 year or the length of your Vivint Service Agreement, whichever is longer
Night Vision	• 39.4 feet (max distance)
Camera Lens	• 1/2.9", 2.19-megapixel sensor
Max Resolution	• Full 1080p HD
Video Codec	• H.264, MPEG-4, MJPEG

Source: <https://support.vivint.com/s/article/Products-Vivint-Outdoor-Camera-V2>

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[1h] storing the recorded events;	<p>Vivint cameras include two methods of storage, local and cloud. Vivint cameras can upload 24/7 recordings from the camera to the Vivint cloud or store clips of events locally. This ensures that even if the power goes out, the data is stored locally. Additionally, Vivint can store recordings locally on a physical Vivint Smart Drive. <i>See below.</i></p> <p>Unlike cloud storage solutions that simply rent out Amazon servers, Space Monkey actually manufactures hardware. This means that the initial investment is slightly higher; however, the service is much cheaper than its competitors in the long run. While most cloud storage solutions cost about \$100 per year for 1 terabyte of storage, Space Monkey costs \$200 to start (for the hard drive) and \$50 per year thereafter for the same terabyte of storage.</p> <p>The result? A cloud storage solution that offers both remote network backup and local storage for the highest level of functionality, data security, and redundancy. Vivint's cloud storage services are fast, secure, on everyone's devices, automatically backed up, easy to share, and accessible from anywhere.</p> <p>Source: https://www.vivint.com/resources/article/the-innovation-behind-vivint-cloud-storage-solutions</p> <p>Do you have to have a DVR for security cameras?</p> <p>Your security cameras themselves will store a certain amount of footage. Vivint cameras record 20- to 90-second clips, depending on the camera, for up to 14 days.</p> <p>A DVR like Vivint Smart Drive—a 1T, low-cost video storage solution—can help you get the most out of your security camera video with a number of helpful benefits, including:</p> <ul style="list-style-type: none"> • Continuous recording that saves footage from up to four different cameras. • Event markers that show motion-triggered activity for quicker searches. • The ability to keep a record of every minute for 30 days. • Smart Clips make it easy to download and share videos with friends, family, or authorities. <p>See why else it makes sense to have a DVR for your security cameras.</p> <p>Source: https://www.vivint.com/products/video-recording</p>
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[1i] wherein transmitting an event of interest comprises the following processes: transmitting immediately when directed and

Vivint cameras can transmit data from events of interest right away due to the immediate alert a user receives when an event of interest occurs in range of a device. Examples of events of interest include motion detection.

MOTION SENSOR

Better motion detection and smart home connection

Vivint motion sensors provide complete coverage around the clock. When your system's armed, your motion sensors will trigger a motion alarm, alert our 24/7 monitoring team, and notify you immediately.

What is a motion sensor alarm?

A motion sensor alarm is the alarm that sounds when a motion sensor is triggered. With Vivint, all of your security devices connect seamlessly on one simple platform, which means your motion sensors communicate directly with your alarm system and control panel. When the system is armed and motion is detected, your motion sensors will trigger the motion sensor alarm, alert you on the Vivint app, and contact our 24/7 monitoring team.

Source: <https://www.vivint.com/products/motion-sensor>

How do outdoor security cameras work?

The Vivint Outdoor Camera Pro works to protect you through the following features:

- A wide-angle lens with night vision.
- Smart Sentry™ person detection and threat deterrence.
- Two-way talk.
- Smart notifications right on your phone.

Learn more about how [outdoor security cameras](#) work.

Source: <https://www.vivint.com/products/outdoor-camera>

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[1j] storing if immediate transmission fails;

Vivint cameras can store data locally or on the Vivint Smart Drive. This way, the data is stored even if transmission fails, such as in a power outage or if phone lines have been cut. Additionally, the Vivint Smart Hub can sync with Vivint cameras and allows camera users to access camera transmissions, even if immediate transmission to the Vivint cloud fails. *See below.*

How long do home security cameras keep footage?

Vivint offers multiple security cameras that record and store footage, including:

- Vivint Doorbell Camera Pro
- Vivint Outdoor Camera Pro
- Vivint Ping Camera

Do you have to have a DVR for security cameras?

Your security cameras themselves will store a certain amount of footage. Vivint cameras record 20- to 90-second clips, depending on the camera, for up to 14 days.


A DVR like Vivint Smart Drive—a 1T, low-cost video storage solution—can help you get the most out of your security camera video with a number of helpful benefits, including:

- Continuous recording that saves footage from up to four different cameras.
- Event markers that show motion-triggered activity for quicker searches.
- The ability to keep a record of every minute for 30 days.
- Smart Clips make it easy to download and share videos with friends, family, or authorities.

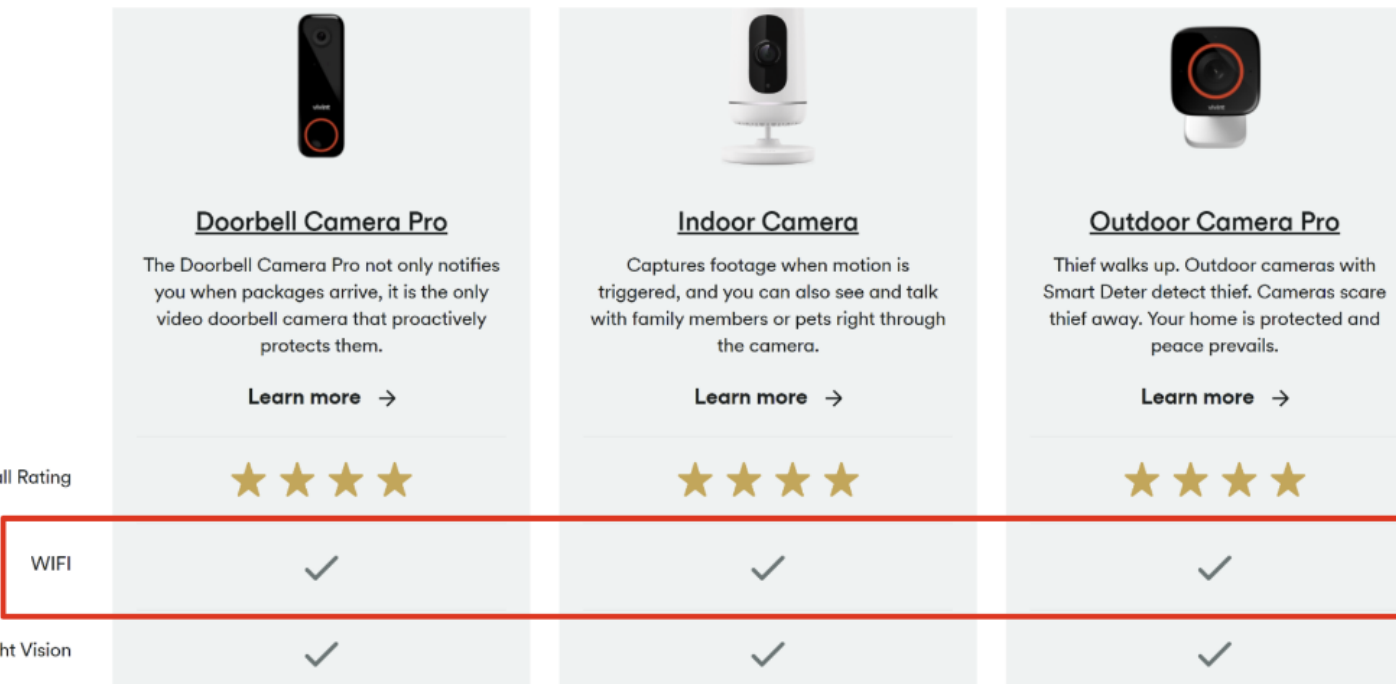
See why else it makes sense to have a [DVR for your security cameras](#).

Source: <https://www.vivint.com/products/video-recording>

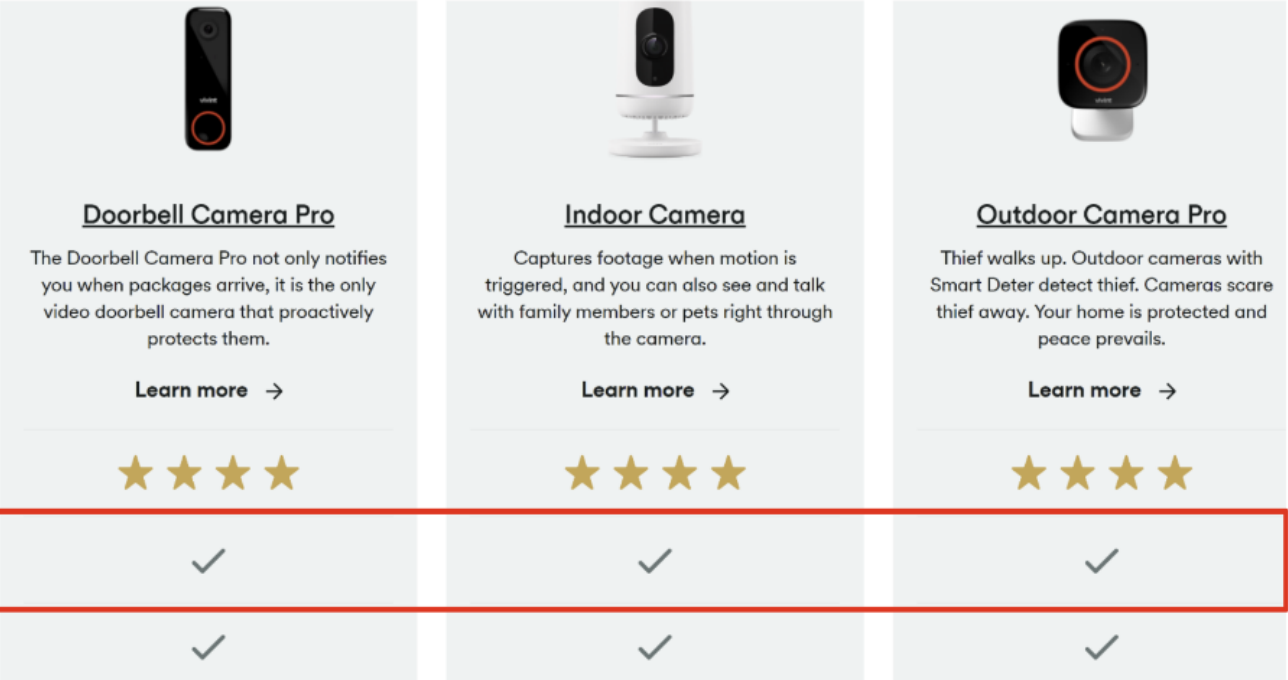
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	<p>SMART HUB</p> <h2>Manage your whole system from a single control panel</h2> <p>Answer the door, arm your system, or view security camera video—all from the Vivint Smart Hub in your home.</p> <p>844.210.1397</p>  <p>How does a smart home hub work?</p> <p>The Vivint Smart Hub is LTE cellular-connected and also uses encrypted Wi-Fi to connect your entire system and give you complete control. If there's a power outage, there's no need to worry, the hub also has 24-hour battery backup.</p> <p>Learn more about how a connected security system keeps your home safe and secure.</p> <p>Source: https://www.vivint.com/products/smart-hub#form-picker-1019951</p>
[1k] opening an https client session;	<p>As shown below, Vivint sends the camera data online to the Vivint cloud. This can occur through a wifi connection. On information and belief, Vivint sends the camera data to the cloud by opening an https client session.</p> <h2>Cloud Storage</h2> <p>Among the many advanced features of a wireless home surveillance system from Vivint, cloud storage is one of the key components that connect it all. All images and video clips recorded with a Vivint surveillance system are automatically transferred via your home's Wi-Fi network to Vivint Smart Drive cloud storage. This convenient storage allows you to access your clips at any time from your home's control panel, the Vivint app, or your online account.</p> <p>Source: https://www.vivint.com/resources/article/how-do-wireless-security-cameras-work</p>

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	 <p>Doorbell Camera Pro The Doorbell Camera Pro not only notifies you when packages arrive, it is the only video doorbell camera that proactively protects them. Learn more →</p> <p>Indoor Camera Captures footage when motion is triggered, and you can also see and talk with family members or pets right through the camera. Learn more →</p> <p>Outdoor Camera Pro Thief walks up. Outdoor cameras with Smart Deter detect thief. Cameras scare thief away. Your home is protected and peace prevails. Learn more →</p> <p>Overall Rating ★ ★ ★ ★</p> <p>WIFI ✓</p> <p>Night Vision ✓</p> <p>Source: https://www.vivint.com/packages/security-cameras</p>
[11] opening an https server session;	<p>Vivint sends the camera data from their cameras to their cloud servers as shown below. This can occur through a wifi connection. On information and belief, Vivint does this by opening an https server session.</p> <p>Cloud Storage</p> <p>Among the many advanced features of a wireless home surveillance system from Vivint, cloud storage is one of the key components that connect it all. All images and video clips recorded with a Vivint surveillance system are automatically transferred via your home's Wi-Fi network to Vivint Smart Drive cloud storage. This convenient storage allows you to access your clips at any time from your home's control panel, the <u>Vivint app</u>, or your online account.</p> <p>Source: https://www.vivint.com/resources/article/how-do-wireless-security-cameras-work</p>

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	 <p>Doorbell Camera Pro The Doorbell Camera Pro not only notifies you when packages arrive, it is the only video doorbell camera that proactively protects them. Learn more →</p> <p>Indoor Camera Captures footage when motion is triggered, and you can also see and talk with family members or pets right through the camera. Learn more →</p> <p>Outdoor Camera Pro Thief walks up. Outdoor cameras with Smart Deter detect thief. Cameras scare thief away. Your home is protected and peace prevails. Learn more →</p> <p>Overall Rating ★ ★ ★ ★</p> <p>WIFI ✓</p> <p>Night Vision ✓</p> <p>Source: https://www.vivint.com/packages/security-cameras</p>
[1m] connecting between an https client and server;	Vivint can connect between a customer's on-site camera and their servers as shown in the image below. This connection takes data from the https client and camera to the cloud server.

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	<p>How do wireless cameras work?</p> <p>Wireless cameras work by transmitting the camera's video through a radio (RF) transmitter. The video is sent to a receiver that is connected to a built-in storage device or through cloud storage. Through your monitor or receiver, you'll have an easy link to access all of your image or video clips.</p> <p>Vivint <u>home security systems</u> provide a number of valuable safety benefits for property owners. But a wireless security camera system may probably be one of the most beneficial of all components for your house.</p> <p>That's because of five standard functions wireless security cameras introduce to home security systems. Those are:</p> <ul style="list-style-type: none"> • motion detection • wireless technology • scheduled recording • remote viewing • automatic cloud storage <p>Those security camera functions have made Vivint home security systems now more effective than ever.</p> <p>Source: https://www.Vivintsecurity.com/shop/premium-indoor-camera.html</p>
[1n] transmitting with link level encryption;	Vivint can encrypt data at every step of transmission which constitutes link level encryption.

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Main Features of IP Cameras

There exist common types of features that every Ip camera must have. For instance, they have built-in and cloud storage capabilities. When you walk into an electronic shop to buy an IP camera, it is essential to consider its storage space. The law requires IP camera companies to retain security footage for a specified period depending on their local jurisprudence and industry. Most systems transmit video information onto a Hard Disk Drive (HDD), a Solid-State Drive (SSD), or cloud storage. The most advanced systems store their recordings locally on HDD or SSD while at the same time back the data in the cloud. Also, the IP cameras have Video Data Encryption that determines the level of security for the camera in question. Encryption is a mechanism of concealing information via data scrambling to allow decoding by authorized parties only. This prevents hackers from compromising the data or disabling the system. Also, IP cameras powered via a PoE connection have the PoE capacities that eliminate the cost and risk of running electrical wires. PoE cameras have stable information transmission and are less prone to interference from local devices. Another notable feature of the current IP cameras is instantly sharing videos via



Source: <https://vivint.security/ip-cameras/>

Effective encryption

In a wireless network, “encryption” is the process of coding signals so that only authorized devices can read them. Make sure encryption is enabled on your Wi-Fi router, and on all the devices on the network.

All quality home security systems have some level of encryption, but there’s a big difference between industry-leading encryption methods and older technology. The best systems have jamming-device detection, tamper resistance, and regular software updates. With any system, keep both the software and hardware updated.

Source: <https://www.vivint.com/resources/article/how-to-prevent-wired-wireless-security-system-breaches>

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<p>[1o] storing recorded events of interest locally; and</p>	<p>Vivint cameras can store data locally themselves or with a Vivint Smart Drive. These recordings include the recorded events of interest. <i>See below.</i></p> <p>Do you have to have a DVR for security cameras?</p> <p>Your security cameras themselves will store a certain amount of footage. Vivint cameras record 20- to 90-second clips, depending on the camera, for up to 14 days.</p> <p>A DVR like Vivint Smart Drive—a 1T, low-cost video storage solution—can help you get the most out of your security camera video with a number of helpful benefits, including:</p> <ul style="list-style-type: none"> • Continuous recording that saves footage from up to four different cameras. • Event markers that show motion-triggered activity for quicker searches. • The ability to keep a record of every minute for 30 days. • Smart Clips make it easy to download and share videos with friends, family, or authorities. <p>See why else it makes sense to have a DVR for your security cameras.</p> <p>Source: https://www.vivint.com/products/video-recording</p>
<p>[1p] transmitting when an acceptable amount of bandwidth becomes available.</p>	<p>Vivint cameras can record locally, and if a secure internet connection with sufficient bandwidth is present, transmit the data to the Vivint cloud. For example, the Vivint Indoor Camera needs a constant upload speed of at least 2 Mbps to transmit data to the Vivint cloud. <i>See below.</i></p> <p>Do Vivint Cameras Work Offline?</p> <p>Since Vivint is a truly wireless system, your Vivint cameras may record while offline, but you'll not be able to access live video monitoring and security alerts via the app.</p> <p>Your Vivint camera, like other smart devices, is solely dependent on your home's Wi-Fi connection and speed. Vivint recommends having at least 2 MBPS of upload speed for each camera. If your home's Wi-Fi connection is unreliable or drops off, you may experience a persistent offline camera status.</p> <p>Using your Vivint cameras offline will limit your access to advanced smart camera features offered by Vivint and leave your home unprotected. Just like any other smart device, you should consider getting a better Wi-Fi router or switch your internet provider to keep your security camera online.</p>

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	<p>Conclusion</p> <p>While Vivint cameras do not need Wi-Fi to record footage, a stable network connection allows you to access a variety of remote and other smart features, such as live monitoring and receiving security notifications through the Vivint app.</p> <p>Fortunately, if your Vivint camera happens to lose its connection to your home’s Wi-Fi network for any reason, it’s easy to reconnect again.</p> <p>Source: https://smarthomestarter.com/do-vivint-cameras-work-without-wi-fi/</p>
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Exhibit D

to

Complaint

for Patent Infringement

Claim Chart¹ for the '069


Patent

¹ Plaintiff provides this exemplary claim chart for the purposes of showing one basis of infringement of one of the Patents-in-suit by Defendant's Accused Products as defined in the Complaint. This exemplary claim chart addresses the Accused Products broadly based on the fact that the Accused Products infringe in the same general way. Plaintiff reserves its right to amend and fully provide its infringement arguments and evidence thereof until its Preliminary and Final Infringement Contentions are later produced according to the court's scheduling order in this case.


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CLAIM CHART

U.S. PATENT NO. 9,472,069 B2– CLAIM 1

Claim 1	Corresponding Structure in Accused Systems – Vivint
<p>[1a] A method for generating and storing an asset from a Point of Recordation Terminal (PORT), comprising:</p>	<p>Vivint sells a camera coupled with a cloud storage service and an app to monitor a home and record continuously while also alerting to specific events. <i>See</i> https://www.vivint.com.</p> <p>Vivint’s wifi-enabled cameras recognize, capture, and store photo and video assets in the cloud through the internet. These products (“Accused Products” or Vivint “devices”) form a point of recordation terminal and operate to generate and store an asset from the Accused Products. Vivint devices are configured to upload and store photo and video assets to be downloaded/streamed and watched later.</p> <p>For example, Vivint devices, together with the Vivint App can generate and store an asset captured from a Vivint device. <i>See</i> below.</p> <div data-bbox="678 750 1133 1209">  <p><u>Indoor Camera</u></p> <p>Captures footage when motion is triggered, and you can also see and talk with family members or pets right through the camera.</p> </div> <p>Source: https://www.vivint.com/packages/security-cameras</p>

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	 <p>Source: https://www.vivint.com/products/video-recording</p>
<p>[1b] collecting a unique identification of the PORT;</p>	<p>Vivint uses MAC addresses to uniquely identify each device. Furthermore, users can uniquely name their cameras for ease of use.</p> <p>6. Click the Find Cameras button. A list of available cameras will be displayed. Usually, the camera you're trying to install will be the only one to show up. To be sure, make sure the MAC address matches the one on the label on the back of your camera.</p> <p>Source: https://support.vivint.com/s/article/Fixed-Camera-V520IR-Installation-Guide</p>
<p>[1c] determining an event of interest by the PORT;</p>	<p>Vivint uses motion detection to determine an event of interest.</p>

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	<p>EVENT MARKERS</p> <h1>Easily share important home security video clips</h1> <p>No more sifting through hours of footage. Vivint does it all for you with event markers that show motion-triggered activity. Finding clips for authorities or sending them to a friend is easy with security DVR.</p> <p>Source: https://www.vivint.com/products/video-recording</p>
<p>[1d] generating multiple representations of the event of interest determined by the PORT, wherein the multiple representations include both video and still images of the event derived from the video;</p>	<p>When an event of interest occurs, the Vivint camera creates a short video of the event. This is either done through taking a part of the continuous stream or beginning to record when the event starts. Within the Vivint app users can watch the recorded videos. The videos have thumbnails shown in the app which are still images of the event derived from the video.</p>

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BUILT-IN MOTION DETECTION

Recording starts when motion is detected

Set cameras by the front and back doors to function as motion-activated security cameras that automatically record a clip when the alarm goes off. If something moves, you'll get a notification on your phone and you can easily check in to make sure everything's fine.

Source: <https://www.vivint.com/products/ping>



24/7 VIDEO RECORDING

Recording that never stops

The Vivint Smart Drive stores every minute of footage from your indoor, outdoor, and doorbell camera for 30 days. Review recordings from up to four of your video cameras right from the Vivint app or Smart Hub with security DVR. Since Vivint cameras feature night vision and capture sharp audio, watching your recordings gives you a clear idea of what's happening in and around your home, day and night.

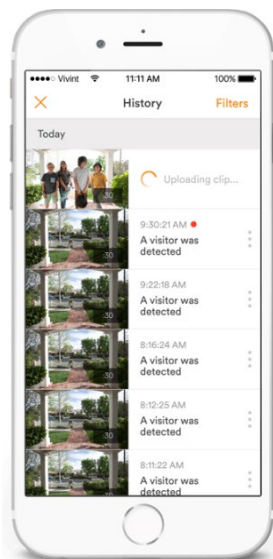
How to buy →

Source: <https://www.vivint.com/products/video-recording>

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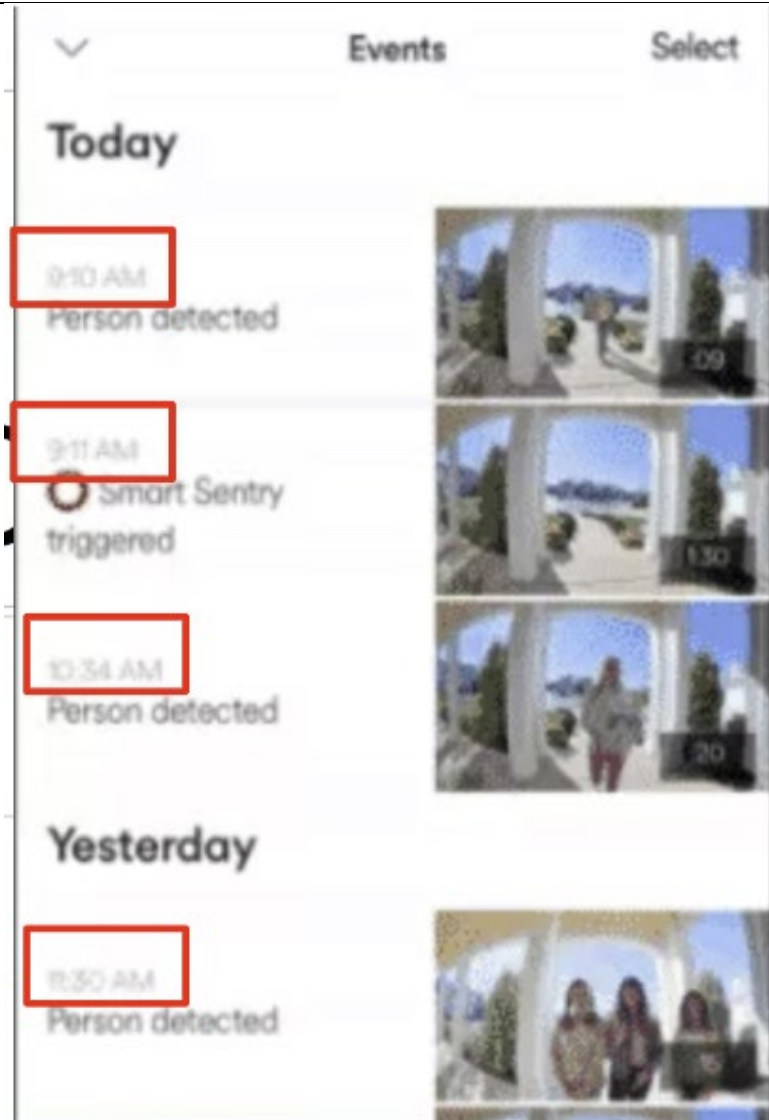
[1e] identifying timing relationship between the multiple representations of the event of interest determined by the PORT;

The Vivint camera timestamps the recordings. When viewed on the app, the events of interest are shown with the time at which the event occurred.



Source: <https://www.vivintsource.com/equipment/outdoor-security-camera>

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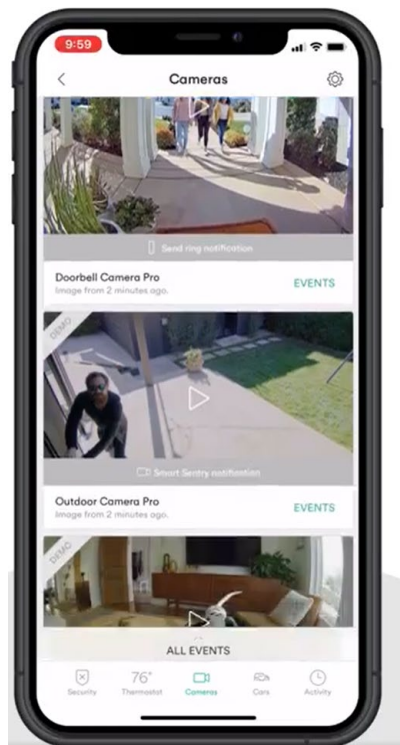


Source: <https://vivint.security/vivint-smart-drive/>

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[1f] associating the unique identification of the PORT with the multiple representations of the event of interest determined by the PORT;

Each event shown in the Vivint app has the name of the device that captured the event tagged in the representation of the event.



Source: <https://www.facebook.com/VivintHome/videos/vivint-smart-home-app-demo-mode/1107912236340948/>

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[1g] encrypting and uploading the multiple representations of the event of interest with the unique identification of the PORT for cloud storage.

Vivint encrypts data when transferring that data between devices. This includes both the video representations of the event and the name of the PORT that captured the event.

Can Vivint Be Hacked?

Vivint works hard to ensure that all their devices are secure. They use 1024-bit encryption, and you can hide the IP addresses of connected devices. However, there

Source: <https://smarthomestarter.com/does-vivint-spy-on-you/>

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Main Features of IP Cameras

There exist common types of features that every IP camera must have. For instance, they have built-in and cloud storage capabilities. When you walk into an electronic shop to buy an IP camera, it is essential to consider its storage space. The law requires IP camera companies to retain security footage for a specified period depending on their local jurisprudence and industry. Most systems transmit video information onto a Hard Disk Drive (HDD), a Solid-State Drive (SSD), or cloud storage. The most advanced systems store their recordings locally on HDD or SSD while at the same time back the data in the cloud. Also, the IP cameras have Video Data Encryption that determines the level of security for the camera in question. Encryption is a mechanism of concealing information via data scrambling to allow decoding by authorized parties only. This prevents hackers from compromising the data or disabling the system. Also, IP cameras powered via a PoE connection have the PoE capacities that eliminate the cost and risk of running electrical wires. PoE cameras have stable information transmission and are less prone to interference from local devices. Another notable feature of the current IP cameras is instantly sharing videos via emails, live links, or SMS. This reduces the time required to share details whenever an incident occurs. Some surveillance systems have edge-based video analytics that use artificial intelligence to detect objects and people in the camera's view.



Source: <https://vivint.security/ip-cameras/>

Effective encryption

In a wireless network, “encryption” is the process of coding signals so that only authorized devices can read them. Make sure encryption is enabled on your Wi-Fi router, and on all the devices on the network.

All quality home security systems have some level of encryption, but there’s a big difference between industry-leading encryption methods and older technology. The best systems have jamming-device detection, tamper resistance, and regular software updates. With any system, keep both the software and hardware updated.

Source: <https://www.vivint.com/resources/article/how-to-prevent-wired-wireless-security-system-breaches>